

Appendix A: Literature Review of Existing Policies

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1 Overview

This appendix was submitted as an intermediate deliverable provided to the State of Washington, in which policies implemented in other jurisdictions were researched in the literature, and summarized across a variety of topics. Table 1 summarizes the primary sections that are included in each policy analysis, and defines some of the basic terms and concepts applied.

Table 1. This table presents the primary sections included in each policy analysis and describes the categories used to evaluate data and analyses from other jurisdictions.

GHG Costs and Benefits	
Cost of Reductions	Provides an indication of overall cost effectiveness, ideally represented in dollars per metric ton of CO ₂ e avoided. However, this metric was not always available in the literature, and in its place summary costs of program implementation or funding levels have been provided.
Volume of Reductions	Represents the quantity of GHG emissions reductions that have been attributed to a given policy.
Programmatic Status	Summarizes observations about the program or policy's successes or failures, and indicates its current operational status.
Emissions Leakage	Emissions leakage occurs when reducing emissions in one jurisdiction or from one source leads to an increase in emissions in another jurisdiction or from another source. For example, cordon areas, defined as zones for which drivers are assessed a charge for passing into or out of, may cause motorists to avoid these roads and congest non-cordon roads, resulting in increased emissions in those congested areas.
Energy and Economic Impacts	
Independence from Fossil Fuels, and Economic Impact	Summarizes any reductions in fossil fuel use as a result of the policy, providing any costs and benefits associated with these reductions.
Impacts on Fuel Choice	Documents how a policy affects consumer and business decisions on fuel choice.
Opportunity for Investments in Infrastructure and Clean Energy/Energy Efficiency	Qualitatively assesses opportunities for new manufacturing infrastructure, and investments in cleaner energy and energy efficiency. This category also includes data relating to jobs and job creation, specifically focusing on in-state opportunities.
Impact on Different Sectors of the Economy	Categorizes the relative impact upon different sectors of the jurisdiction's economy, including power rates, agriculture, manufacturing, and transportation fuel costs.
Household Impacts and Co-Benefits	
Effect on Household Consumption and Spending	Reviews any impacts to individuals and households with specific attention to income, energy savings, fuel, food, and housing costs.
Measures to Mitigate to Low-income Populations, or Economic Impact	Accounts for any actions taken to mitigate economic burden on low-income populations that are impacted by the policy. Examples of policy actions include tax credits or increases in family benefit payments, pensions and allowances to assist households to meet cost increases.

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Significant Co-benefits	Presents any environmental, health, or economic co-benefits associated with the policy type. For example, an increase in the adoption of commercial heavy duty electric trucks as a result of purchase incentives can reduce GHG emissions and also improve public health as a result of decreased criteria pollutant emissions.
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2 California Cap-and-Trade Program

Policy Definition		Targeted Sector or Emissions
The California Cap and Trade program is the centerpiece of California's AB32 compliance strategy. It places a cap on total covered GHG emissions, and allows trading among regulated industry.		Economy-wide (Electricity, RCI, Transportation, Industrial Process)
GHGs and Costs		
<ul style="list-style-type: none"> 146.7 MMTCO₂e reductions in 2020 from the capped sector, of which 34.4 MMTCO₂e reductions are attributed to cap (not driven by complementary policy) Cost of reductions estimated at \$15-30 per tCO₂e through 2020. 		
Implementation Issues and Lessons Learned		
<ul style="list-style-type: none"> Includes cost containment mechanisms including offsets, free allocation, and price containment reserves. Faced legal challenges to use of offsets. Policy to address resource shuffling and potential GHG leakage (displacement of emissions to another jurisdiction) must reconcile grid reliability issues. 		
Costs and Benefits to Consumers		Costs and Benefits to Businesses
<ul style="list-style-type: none"> ARB estimates minimal, if any, impact on household income (0 to 0.1 percent decrease) Modest decrease in labor demand (0.3 to 0.6 percent) under expected prices. Residential expenses are anticipated to increase 0.5 to 0.6 percent in 2020, while transportation expenses decrease 0.3 percent. To mitigate impact to electricity rates, the regulation includes the Allocation to Electrical Distribution Utilities for the Protection of Electricity Ratepayers. 		<ul style="list-style-type: none"> ARB anticipates increased investments in efficient buildings, technologies, and advanced fuels. Cap and Trade program will reduce total economic output by a modest 0.1 percent, from 2.4 to 2.3 percent. Projected shift towards sectors driven by cleaner and more efficient technologies. Small business energy expenses are expected to increase by 0.2 percent to 2.7 percent. A report by BCG estimates detrimental impacts and job losses in the oil refining sector, including increased production costs of up to \$0.69 per gallon, though the assumptions underlying these findings have been contested by expert review.

The California Global Warming Solutions Act of 2006 (AB 32) set targets for greenhouse gas (GHG) reductions in the State of California relative to an anticipated business as usual trajectory. By 2020, the bill calls for California emissions to return to the 1990 level of 427 million metric tons of carbon dioxide equivalent (MMTCO₂e), a reduction of approximately 77 MMTCO₂e. To reach this goal, the AB 32 Climate Change Scoping Plan Document established a suite of policy mechanisms with a cap-and-trade program as the centerpiece.¹

¹ California Air Resources Board. December 2008. Climate Change Scoping Plan: a framework for change. Accessed August 2013 at: http://www.arb.ca.gov/cc/scopingplan/document/adopted_scoping_plan.pdf

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The California Cap and Trade Program will regulate approximately 35 percent of California's GHG emissions in the first compliance period (2013-2014) by covering the electricity sector and certain industrial sectors. The program will expand to cover 85 percent of California emissions in the second and third compliance periods (2015-2017 and 2018-2020) when transportation fuels and natural gas suppliers are included. In addition to emissions from in-state sources, electricity imported to California is also subject to a compliance obligation corresponding to its emissions. This compliance obligation is the responsibility of the electricity importer, and not the out-of-state entity generating the power.²

The California program allows the use of GHG offsets to meet up to 8 percent of each regulated entity's compliance obligation. The California Air Resources Board (ARB) has adopted four offset protocols for use, and has approved two private organizations to assist in implementation of the offsets program as Offset Project Registries. There is general concern, however, that there will be insufficient offset supply to meet the demand, particularly in early years, and many regulated entities are pushing ARB to develop additional categories of eligible projects. The four offset protocols approved by ARB and two additional project types currently being developed by ARB through a public process are:³

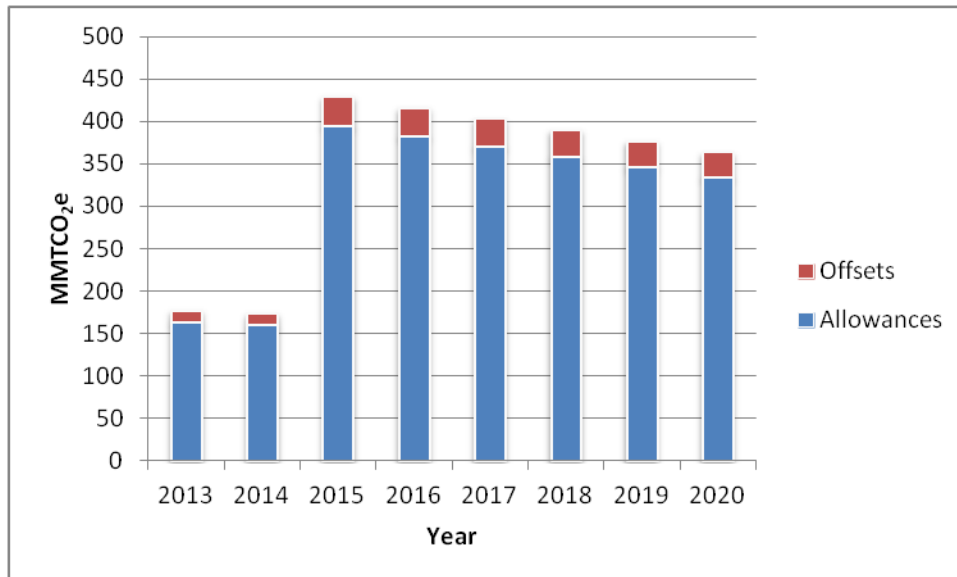
- U.S. Forest Projects Compliance Offset Protocol
- Urban Forest Projects Compliance Offset Protocol
- Livestock Projects Compliance Offset Protocol
- Ozone-Depleting Substance (ODS) Compliance Offset Protocol
- Mine Methane Capture Compliance Offset Protocol (under development)
- Rice Cultivation Compliance Offset Protocol (under development)

Figure 1 below shows the annual emission caps for California under AB 32. The blue area indicates the total allowances issued by the state, which is equal to the cap. The red area represents the maximum quantity of GHG offsets that could be used *in addition to allowances* to cover regulated emissions. The use of offsets allows an increase in covered emissions, but requires a decrease in emissions from non-covered sources. There is a large increase in the cap in 2015, when transportation fuels and natural gas suppliers are added.

² California Environmental Protection Agency, Air Resources Board. April 2013. Article 5: California Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanisms. Accessed July 2013 at: http://www.arb.ca.gov/cc/capandtrade/ct_rf_april2013.pdf

³ California Air Resources Board. June 2013. Compliance Offset Program. Accessed August 2013 at: <http://www.arb.ca.gov/cc/capandtrade/offsets/offsets.htm>

Figure 1: Cap on California GHGs under AB 32⁴



Allowances are distributed through a variety of mechanisms including free allocation to industry, free allocation to electricity distributors (for the benefit of ratepayers), and auctions. The percent of freely allocated allowances will decline over time. For vintage 2013, over 90 percent of allowances were freely allocated, with the following distribution:^{5,6}

- 53,894,995 MMTCO₂e freely allocated to industry
- 65,196,769 MMTCO₂e freely allocated to investor-owned electric utilities
- 30,514,316 MMTCO₂e freely allocated to publicly-owned electric utilities
- 132,603 MMTCO₂e freely allocated to electric co-ops.

Auctions are held on a quarterly basis and include both current vintage allowances and an advance auction of future vintage allowances. The auction mechanism utilizes a settlement price corresponding to the minimum price – working downwards from the highest bid – at which all available allowances are sold. There is also a price floor below which allowances will not be sold. The price floor was \$10.00 in 2012, increasing five percent plus inflation each year

⁴ California Code of Regulations. July 2013. California Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanism to Allow for the Use of Compliance Instruments Issued by Linked Jurisdictions. Accessed August 2013 at: <http://www.arb.ca.gov/cc/capandtrade/ctlinkqc.pdf>

⁵ California Air Resources Board. January 2013. Vintage 2013 Industrial Allowance Allocation by Sector. Accessed August 2013 at: http://www.arb.ca.gov/cc/capandtrade/allowanceallocation/sector_based_industrial_allocation.pdf

⁶ California Air Resources Board. September 2012. Annual Allocation to Electrical Distribution Utilities under the Cap-and-Trade Program (Sections 95892 and 95870). Accessed August 2013 at: http://www.arb.ca.gov/cc/capandtrade/allowanceallocation/electricity_allocation.pdf

thereafter. There have been three auctions conducted to date, with prices for current vintages ranging from \$10.09 to \$14.00 per mtCO₂e.⁷

The California program has been designed under the Western Climate Initiative (WCI) and with WCI partners, and from the beginning has been intended to link to other cap and trade programs.⁸ In February 2007, the Governors of Arizona, California, New Mexico, Oregon, and Washington signed an agreement to develop a regional target for GHG emission reductions and develop a market-based program to achieve the target, establishing the WCI.⁹ The Governors of Montana and Utah and the Premiers of British Columbia, Manitoba, Ontario, and Quebec joined the WCI during 2007 and 2008. However, the shifting political landscape in the region, along with economic concerns from the financial crisis, led several states to pull out of the WCI. Arizona, Montana, New Mexico, Oregon, Utah and Washington formally withdrew from the WCI in 2011. California, British Columbia, Ontario, Quebec and Manitoba are continuing to work together through Western Climate Initiative, Inc. (WCI, Inc.) to develop a cap-and-trade program.¹⁰ California and Quebec have developed cap and trade programs, and these are poised to be linked beginning in 2014. California Governor Jerry Brown formally approved linkage in 2013, and staff in California and Quebec are working to establish necessary policy frameworks.¹¹ The California cap and trade program presents an opportunity for the state of Washington, should it pursue a cap and trade program, to link with it and potentially other partners to create a larger cap and trade program.

2.1 GHG Impacts

The California Cap and Trade program is one of over a dozen policies implemented under AB 32, and is expected to work in conjunction with complementary policies to reduce GHG emissions. Many of the complementary policies target covered emissions, and emission reductions from these policies may not be attributable to cap and trade. In total, California projects achieving 146.7 MMTCO₂e reductions in 2020 from the capped sector. Of these, 112.3 MMTCO₂e are expected to come from complementary policies. Market forces associated with

⁷ California Air Resources Board. July 2013. Auction Information. Accessed August 2013 at: <http://www.arb.ca.gov/cc/capandtrade/auction/auction.htm>

⁸ Western Climate Initiative. March 2009. Design Recommendations for the WCI Regional Cap-and-Trade Program. Accessed August 2013 at: <http://www.westernclimateinitiative.org/document-archives/wci-design-recommendations>

⁹ Western Climate Initiative. Archived site. <http://www.westernclimateinitiative.org/index.php>

¹⁰ Western Climate Initiative, Inc. (WCI, Inc.) is a non-profit corporation formed to provide administrative and technical services to support the implementation of state and provincial greenhouse gas emissions trading programs. WCI Inc. <http://www.wci-inc.org/index.php>

¹¹ California Environmental Protection Agency, Air Resources Board. April 2013. Air Resources Board sets date for linking cap-and-trade program with Quebec. Accessed July 2013 at: <http://www.arb.ca.gov/newsrel/newsrelease.php?id=430>

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cap and trade are expected to generate the additional 34.4 MMTCO₂e reductions necessary to meet the 2020 cap, and to facilitate the complementary measures.¹²

As the program is in the first year of its first compliance period, it is too early to assess programmatic success or costs. Early auction results saw prices ranging between \$10.00 and \$14.00. However, the allowance cost would only reflect the cost of abatement if there was a perfectly economic market with perfect information, so these prices should not be viewed as a realistic cost of abatement.¹³

Table 2: GHG Costs and Benefits of the CA Cap and Trade Program

California	
Cost of Reductions	<p>According to modeling conducted by the California ARB, the cost of reductions is estimated to be between \$15-\$30 in 2020.¹⁴ Clearing prices from allowance auctions conducted to date are as follows:</p> <ul style="list-style-type: none"> • November 14, 2012: \$10.09 (vintage 2013), \$10.00 (vintage 2015)¹⁵ • February 19, 2013: \$13.62 (vintage 2013), \$10.71 (vintage 2016)¹⁶ • May 16, 2013: \$14.00 (vintage 2013), \$10.71 (vintage 2016)¹⁷
Volume of Reductions	<p>Cap and trade is one of many measures implemented under AB 32, which are cumulatively expected to reduce California emissions by approximately 30 percent (169 MMTCO₂e) relative to the business-as-usual scenario. Emission reductions from the capped sector will be approximately 147 MMTCO₂e in 2020, and cap and trade itself is expected to be responsible for approximately 34 MMTCO₂e reductions in 2020.¹⁸</p>
Programmatic Status	<p>California is in the first year of its program and it is too early to judge success.</p>

¹² California Air Resources Board. December 2008. Climate Change Scoping Plan: a framework for change. Accessed August 2013 at: http://www.arb.ca.gov/cc/scopingplan/document/adopted_scoping_plan.pdf

¹³ In a perfectly efficient market, the cost of allowances would be equal to the cost of reducing a ton of CO₂e. This would occur because firms whose costs of abatement were higher than the prevailing market price would purchase allowances rather than reduce emissions, and those whose costs of abatement were lower than the market price would reduce emissions at this lower cost in order to sell allowances at the higher cost.

¹⁴ California Air Resources Board. October 2010. Staff Report: Initial Statement of Reasons. Accessed August 2013 at: <http://www.arb.ca.gov/regact/2010/capandtrade10/capandtrade10.htm>

¹⁵ California Air Resources Board. June 2013. Quarterly Auction 1, November 2012: Summary Results Report. Accessed August 2013 at: http://www.arb.ca.gov/cc/capandtrade/auction/november_2012/updated_nov_results.pdf

¹⁶ California Air Resources Board. June 2013. Quarterly Auction 2, February 2013: Summary Results Report. Accessed August 2013 at: http://www.arb.ca.gov/cc/capandtrade/auction/february_2013/updated_feb_results.pdf

¹⁷ California Air Resources Board. June 2013. Quarterly Auction 3, May 2013: Summary Results Report. Accessed August 2013 at: http://www.arb.ca.gov/cc/capandtrade/auction/may-2013/updated_may_results.pdf

¹⁸ California Air Resources Board. December 2008. Climate Change Scoping Plan: a framework for change. Accessed August 2013 at: http://www.arb.ca.gov/cc/scopingplan/document/adopted_scoping_plan.pdf

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Emissions Leakage	The California program has been designed to mitigate emission leakage through free allocation of emission allowances to industry. Additionally, concerns have been raised regarding resource shuffling , and rules have been implemented to prevent it. Resource shuffling “involves a plan, scheme, or artifice undertaken by a First Deliverer of electricity to reduce its emissions compliance obligation by engaging in an impermissible substitution of higher emissions resources with relatively lower emissions resources.” ¹⁹ In response to an August 6, 2012 letter from FERC Commissioner Moeller raising a concern about the resource shuffling rules impact on grid reliability ²⁰ , ARB has suspended enforcement of this provision for the first 18 months of active allowance trading. ²¹
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2.2 Energy and Economic Impacts

During the early years of California’s Cap and Trade program, a relatively small portion of allowances will be auctioned, but over time this portion will increase. California estimates that the auction of allowances under California’s Cap and Trade regime will generate billions of dollars for the State of California between the first auction in November 2012 and the program’s third compliance period in 2020, with approximately \$200 million in auction revenues estimated for 2012-2013 and \$400 million in 2013-2014²².

The California Department of Finance (Finance) and ARB drafted, through a public consultation process, a three-year investment plan to identify “investments to help achieve greenhouse gas reduction goals and yield valuable co-benefits.”²³ The intent was that the plan would be submitted to the California Legislature, which would in turn appropriate cap and trade revenue to State agencies for implementation of programs to further the objectives of AB 32. The California Legislature passed a \$96.3 billion budget for the fiscal year 2013-2014 on Friday June 13, 2013. Although the Investment Plan recommended allocating cap and trade revenue to a variety of pre-existing programs that could begin to use the funds immediately, the approved FY 2013-2014 budget instead borrowed the expected \$500 million in auction proceeds to meet other budgetary needs. Governor Brown has stated that he borrowed the \$500 million to provide more time to set up programs that will use the funding effectively. No timetable for repayment has yet been issued.²⁴

¹⁹ California Air Resources Board. Cap-and-Trade Regulation Instructional Guidance, Appendix A: What is Resource Shuffling? November 2012. <http://www.arb.ca.gov/cc/capandtrade/emissionsmarketassessment/resourceshuffling.pdf>

²⁰ Philip D. Moeller. August 6, 2012. Letter to California Governor Edmund G. Brown.

²¹ Mary D. Nichols. August 11, 2012. Letter to Commissioner Philip D. Moeller.

²² State of California, 2013-14 Governor’s Budget Summary, accessed July 2013 at: http://www.dof.ca.gov/documents/FullBudgetSummary_web2013.pdf

²³ California Department of Finance. May 2013. Cap and Trade Auction Proceeds Investment Plan: Fiscal Years 2013-14 through 2015-16, page 1. Accessed August 2013 at: http://www.arb.ca.gov/cc/capandtrade/auctionproceeds/final_investment_plan.pdf

²⁴ Mulkern, Anne C. *Gov. Brown proposes to borrow \$500M from cap-and-trade revenue*. ClimateWire. May 15, 2013

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Estimates on the overall economic impact of the California program vary, though not widely. California ARB modeling indicates that cap and trade will reduce fuel use, and cause only a 0.1 percent decrease to total economic output. These results are generally consistent with two additional macroeconomic studies of the impacts of AB 32 implementation, one by the University of California and another cooperative study by Charles River Associates and the Electric Power Research Institute. Each of these three models projects a full business-as-usual forecast using a general equilibrium macroeconomic approach, and compares it to a forecast under which AB 32 policies including cap and trade have been implemented. All three indicate economic growth. A comparative analysis performed by the Center for Resource Solutions concludes that the ARB modeling is the most sophisticated; therefore these results are provided in the tables that follow.²⁵

A study commissioned by the Western States Petroleum Association (WSPA) and conducted by the Boston Consulting Group (BCG) reached different conclusions. Key findings of the BCG report include an increase in the cost of making gasoline and diesel of \$0.14 to \$0.69 per gallon, with higher costs possible depending on auction prices. Further, BCG concluded that under cap and trade carbon costs could be very volatile in early years, which could in turn cause market disruptions. In conjunction with other policies implemented under AB 32, BCG estimated that refinery closures could result in the loss of 28 to 51 thousand jobs, far outpacing their estimate of 2.5 to 5 thousand jobs in the energy efficiency sector.²⁶

In May 2013, the UC Davis Policy Institute released a report that summarized expert evaluation of the BCG study. The report was funded by the WSPA, Rockefeller Brothers Fund, and the Alliance of Automobile Manufacturers. The expert review generally concluded that the BCG report was too narrow in scope (looked solely at the refining sector), and included a variety of problematic assumptions. The UC Davis report noted that BCG failed to consider other both plausible alternatives to meeting the Low Carbon Fuel Standard that would have lower costs, and the likelihood that the oil refinery sector would diversify into low carbon fuels or line up alternate domestic supplies.²⁷

²⁵ Center for Resource Solutions. 2009. Climate Policy and Economic Growth in California. Accessed September 2013 at: http://www.resource-solutions.org/pub_pdfs/Climate%20Policy%20and%20Economic%20Growth%20in%20California.pdf

²⁶ Boston Consulting Group. 2012. Understanding the impact of AB 32. Accessed September 2013 at: http://cafuelfacts.com/wp-content/uploads/2012/07/BCG_report.pdf

²⁷ UC Davis Policy Institute for Energy, Environment and the Economy. 2013. Expert Evaluation of the Report: "Understanding the Impacts of AB32". Accessed September 2013 at: http://policyinstitute.ucdavis.edu/files/general/pdf/2013-05-09_Expert-Evaluation-of-BCG-Report.pdf
May 2013

Table 3: Energy and Economic Impacts of the CA Cap and Trade Program

California	
Independence from Fossil Fuels, and Economic Impact	California ARB modeling predicts decrease in fuel use by 2 to 4 percent in 2020. ²⁸ Independent analysis also shows that expenditures on out of state crude will be reduced by approximately \$10 billion in 2020. In addition, the value of decreased exposure to fuel price shocks in 2020 is valued at \$18.8 to \$29.6 billion. ²⁹
Impacts on Fuel Choice	Analysis by EDF et al. estimates the avoidance of 75 million barrels of oil and 189 trillion BTUs of natural gas annually. ³⁰
Opportunity for Investments in Infrastructure and Clean Energy/Energy Efficiency	In response to Cap and Trade, ARB anticipates increased investments in efficient buildings, technologies, and advanced fuels. In addition, state revenues from allowance sales will be used to support transportation infrastructure, energy efficiency, and related programs as recommended in the Investment Plan. ³¹
Impact on Different Sectors of the Economy	<p>ARB modeling indicates that the Cap and Trade program will reduce total economic output by a modest 0.1 percent, from 2.4 to 2.3 percent. There is also a projected shift towards sectors driven by cleaner and more efficient technologies. Small business energy expenses are expected to increase by 0.2 percent to 2.7 percent.³²</p> <p>A report by BCG estimates detrimental impacts and job losses in the oil refining sector, including increased production costs of up to \$0.69 per gallon, though the assumptions underlying these findings have been contested by expert review.</p>

In addition to trading, to mitigate potential impacts on California businesses, the program contains several targeted design elements:³³

- **Offsets:** The use of GHG offsets is permitted for up to 8 percent of each regulated entity's annual compliance obligation. However, there is concern that there will not be sufficient supply of offsets to meet this 8 percent ceiling due to the limited number of eligible offset project types. Additionally, the offset market has been slow to develop partially due to a

²⁸ California Air Resources Board. October 2010. Staff Report: Initial Statement of Reasons. Accessed August 2013 at: <http://www.arb.ca.gov/regact/2010/capandtrade10/capandtrade10.htm>

²⁹ Environmental Defense Fund, Center for Resources Solutions, and Energy Independence Now. September 2010. Shockproofing Society: How California's Global Warming Solutions Act (AB 32) Reduces the Economic Pain of Energy Price Shocks. Accessed August 2013 at: http://www.resource-solutions.org/pub_pdfs/Shockproofing%20Society.pdf

³⁰ Ibid.

³¹ California Department of Finance. May 2013. Cap and Trade Auction Proceeds Investment Plan: Fiscal Years 2013-14 through 2015-16, page 1. Accessed August 2013 at: http://www.arb.ca.gov/cc/capandtrade/auctionproceeds/final_investment_plan.pdf

³² California Air Resources Board. October 2010. Staff Report: Initial Statement of Reasons. Accessed August 2013 at: <http://www.arb.ca.gov/regact/2010/capandtrade10/capandtrade10.htm>

³³ California Code of Regulations. July 2013. California Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanism to Allow for the Use of Compliance Instruments Issued by Linked Jurisdictions. Accessed August 2013 at: <http://www.arb.ca.gov/cc/capandtrade/ctlinkqc.pdf>

buyer liability provision which places responsibility for invalidated credits with the regulated entity rather than the offset provider. Various insurance and contract mechanisms are evolving to mitigate invalidation risk.

- **Allocation for Industry Assistance:** To protect the competitiveness of California businesses, the regulation freely allocates a portion of required allowances to California businesses. The industry assistance factor, which defines the percent of allowances allocated to each business, is a value between 30 percent and 100 percent. The industry assistance factor varies based on industry exposure, and decreases through time.
- **Price Containment Reserve:** The price containment reserve withholds four percent of total allowances across all three compliance periods. From the start of the program, this strategic reserve will be available should there be a supply shortage or prices increase in the market above the current price of the containment reserve. At such time, ARB will release allowances from the reserve at a price initially equal to \$40 which escalates in future years.

2.3 Household Impacts and Co-Benefits

The use of the revenue generated to date, and the projected billions in additional funds to be generated in the coming years, is constrained by several pieces of legislation. In addition to AB 32, AB 1532, SB 535, and SB 1018, signed by Governor Brown in 2012 require 25 percent of available money be allocated to projects providing benefit to disadvantaged communities, and 10 percent to projects physically located in disadvantaged communities. To assist this process, CalEPA developed a multi-criteria assessment tool known as CalEnviroScreen, which examines 11 categories of pollution and environmental factors as well as seven population characteristics and socioeconomic factors. The tool analyzes each ZIP code in the state across each indicator to assess both the burden of pollution and population characteristics; the top 10 percent of ZIP codes are deemed “disadvantaged communities.”³⁴ Maps and lists of the ZIP codes identified are publicly available.

Additionally, California’s program design includes several elements intended to mitigate household impacts, including the Allocation to Electrical Distribution Utilities for the Protection of Electricity Ratepayers.³⁵ This element is designed to ensure that ratepayers do not suffer sudden increases in their utility bills as a result of cap and trade. It functions by providing electrical distribution utilities with free allowances that they are required to sell at auction to emitters (in some cases themselves). The revenue generated at auction must then be used by the

³⁴ California Environmental Protection Agency. April 2013. California Communities Environmental Health Screening Tool, Version 1 (CalEnviroScreen 1.0). Accessed August 2013 at: <http://oehha.ca.gov/ej/pdf/042313CalEnviroScreen1.pdf>

³⁵ California Code of Regulations. July 2013. California Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanism to Allow for the Use of Compliance Instruments Issued by Linked Jurisdictions. Accessed August 2013 at: <http://www.arb.ca.gov/cc/capandtrade/ctlinkqc.pdf>

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utility solely to benefit their retail ratepayers.³⁶ The benefit may be delivered in a variety of forms including a bill dividend.³⁷

Table 4: Household Impacts and Co-Benefits of the CA Cap and Trade Program

California	
Effect on Household Consumption and Spending	ARB estimates minimal, if any, impact on household income (0 to 0.1 percent decrease), as well as a modest decrease in labor demand (0.3 to 0.6 percent) under expected prices. Residential expenses are anticipated to increase 0.5 to 0.6 percent in 2020, while transportation expenses decrease 0.3 percent . ³⁸ Separately, EDF et al. values the policy's ability to buffer Californians against the costs of a future fuel price shock at \$332 to \$670 savings per year per household (\$4.8 to \$9.6 billion total, based on projected fuel price ranges). This is in addition to anticipated fuel savings discussed previously. ³⁹
Measures to Mitigate to Low-income Populations, or Economic Impact	To mitigate impact to electricity rates, the regulation includes the Allocation to Electrical Distribution Utilities for the Protection of Electricity Ratepayers . ⁴⁰ Additionally, several pieces of legislation require the expenditure of 25 percent of Cap and Trade revenue to be allocated to projects benefiting disadvantaged communities, and 10 percent spent in those communities. ⁴¹ However, the FY2013-FY2014 budget did not allocate any cap and trade funds for these purposes, instead borrowing \$500 million for other programs. When the \$500 million is repaid, those funds will be subject to these requirements for future spending.
Significant Co-benefits	Overall reduction in criteria pollutants . However, there is also an environmental justice concern. Plaintiffs in a court challenge allege that due to the fact that cap and trade does not require any single source to reduce emissions, some sources may in fact increase emissions and associated criteria pollutants. Should this happen, there would be a detrimental impact on the nearby residents and businesses. ⁴²

³⁶ <http://www.arb.ca.gov/cc/capandtrade/allowanceallocation/allowanceallocation.htm>

³⁷ <http://breakingenergy.com/2013/01/09/california-ratepayers-to-receive-cap-and-trade-dividend/>

³⁸ California Air Resources Board. October 2010. Staff Report: Initial Statement of Reasons. Accessed August 2013 at: <http://www.arb.ca.gov/regact/2010/capandtrade10/capandtrade10.htm>

³⁹ Environmental Defense Fund, Center for Resources Solutions, and Energy Independence Now. September 2010. Shockproofing Society: How California's Global Warming Solutions Act (AB 32) Reduces the Economic Pain of Energy Price Shocks. Accessed August 2013 at: http://www.resource-solutions.org/pub_pdfs/Shockproofing%20Society.pdf

⁴⁰ California Code of Regulations. July 2013. California Cap on Greenhouse Gas Emissions and Market-Based Compliance Mechanism to Allow for the Use of Compliance Instruments Issued by Linked Jurisdictions. Accessed August 2013 at: <http://www.arb.ca.gov/cc/capandtrade/ctlmkqc.pdf>

⁴¹ AB 1532, SB 535, and SB 1018

⁴² See, e.g., *Association of Irrigated Residents, et al. v. California Air Resources Board*

3 Regional Greenhouse Gas Initiative (RGGI)

Policy Definition	Targeted Sector or Emissions
The Regional Greenhouse Gas Initiative (RGGI) is a cooperative effort among nine northeast states in the U.S. to regulate and reduce GHG emissions from the power sector. It places a cap on total electric utility GHG emissions, and allows trading among regulated industry.	Electric Power
GHGs and Costs	
<ul style="list-style-type: none"> Capped electric sector were reduced 13 percent from 2009 to 2012 and according to the 2011 RGGI Investment Report the revenue generated by the auctions has led to strategic energy projects decreasing emissions by 12 million mtCO₂e over the life of the projects. From September 2008 to June 2013, auction clearing prices have ranged from a low of \$1.86 to a high of \$3.51, with an average of \$2.35/mtCO₂e with cumulative proceeds totaling \$1.35 billion.⁴³ 	
Implementation Issues and Lessons Learned	
<ul style="list-style-type: none"> Initial emission cap was set too high, over allocation of allowances led to low market prices. New Jersey withdrew from the program in 2011 citing economic reasons. The most effective program element in reducing GHG emissions has been the reinvestment of allowance revenues collected by the states in energy efficiency and clean energy projects. 	
Costs and Benefits to Consumers	Costs and Benefits to Businesses
<ul style="list-style-type: none"> Through 2011 \$86 million of the collected program funds have gone to low income rate relief energy efficiency improvement programs. Another \$37 million has gone to general rate relief. Households in the RGGI region recognized a nearly \$1.1 billion net gain due to improvements in energy efficiency resulting from RGGI revenues. 	<ul style="list-style-type: none"> Analysis Group estimates 1.6 billion in economic value and 16,000 Job years added to the states. Long term costs to utilities of up to 1.6 billion due to lost revenue from improved consumer efficiency and conservation. Short term costs passed on to consumers. RGGI proceeds for several types of programs leads to more purchases of goods and services.

The Regional Greenhouse Gas Initiative (RGGI) is a cooperative effort among nine northeast states in the U.S. to regulate and reduce GHG emissions from the power sector. RGGI is composed of individually-operating emission trading programs within each state that together have created a regional market for emission allowances. Development of RGGI began in 2003, with the first memorandum of understanding (MOU) being released in 2005. The first auction of emission allowances occurred in 2008, with the first three-year compliance period starting in January 2009. RGGI currently operates in nine Northeast and Mid-Atlantic States in the U.S.: Connecticut, Delaware, Maine, Massachusetts, Maryland, New Hampshire, New York, Rhode Island, and Vermont (New Jersey participated through 2011, but withdrew citing the programs impact on business and consumers as reasoning). Each State program was developed based on the agreed upon RGGI Model Rule, which includes capping emissions from the electric power plants and requiring that a certain percentage of emission allowances are provided through

⁴³ http://www.rggi.org/market/co2_auctions/results

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participation in regional auctions rather than free allocation. Currently, around 90 percent of all allowances are provided through auction, with the remaining sold directly to qualified sectors.⁴⁴

RGGI allows for the use of offsets from certain project types to substitute for emission allowances, up to 3.3 percent of a utility's reported emissions, encouraging investment in particular project types identified as high priority by the states. RGGI has its own offset protocols which cover the following project types:

- Capture or destruction of CH₄ from landfills;
- SF₆ reductions from electricity transmission and distribution equipment;
- CO₂ sequestration through afforestation;
- CO₂ reductions through non-electric end-use energy efficiency in buildings; and,
- Avoided CH₄ emissions through agricultural manure management operations.

RGGI is also looking to replace the existing afforestation offset protocol with a new forestry protocol based on the one used by California's Air Resources Board. This new protocol would cover improved forest management, reforestation, and reduced land use change (forest conversion).⁴⁵

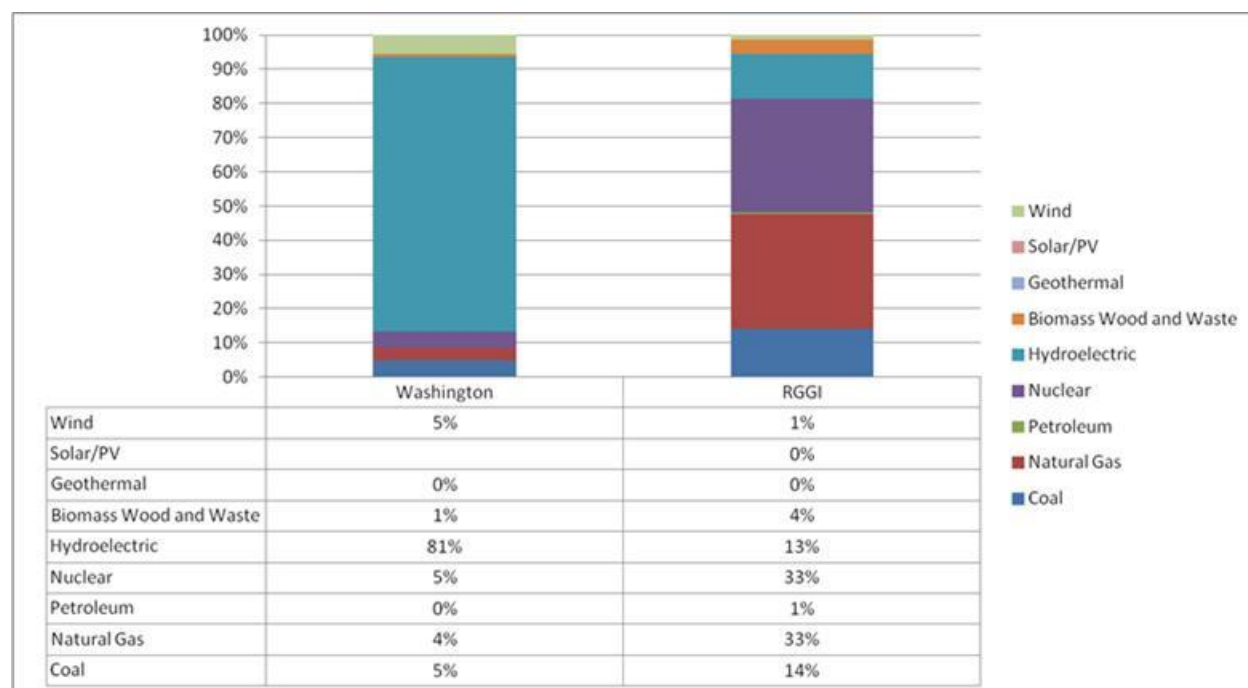
RGGI is highly focused, covering only the electricity sector. Unlike many other cap and trade programs, it does not cover other high emitting sectors, such as industrial manufacturing. The sole focus of RGGI – the electric sector in the northeast – is very different from Washington's electric sector. Figure 2, developed from the U.S Energy Information Administration's electricity production data (for Washington on the left, and the combined electric sector of the RGGI states on the right) shows that about 48 percent of the electric sector is fossil fuel, with another 33 percent from nuclear in the RGGI covered states. These add up to 81 percent, compared to a combined 14 percent for these fuels in Washington State. On the other hand, hydro is 81 percent of in-state generation for Washington and only 13 percent for RGGI-participating states.⁴⁶

⁴⁴ Environmental Defense Fund – “RGGI: The World's Carbon Markets: A Case Study Guide to Emissions Trading”; http://www.ieta.org/assets/Reports/EmissionsTradingAroundTheWorld/edf_ieta_rggi_case_study_may_2013.pdf

⁴⁵ RGGI Program Review News Release: RGGI States Propose Lowering Regional CO₂ Emissions Cap 45%, Implementing a More Flexible Cost-Control Mechanism; http://www.rggi.org/docs/PressReleases/PR130207_ModelRule.pdf

⁴⁶ Energy Information Administration. State Profiles and Energy Estimates, Table C9: Electric Power Sector Consumption Estimates, 2011. Accessed July 2013 at: http://www.eia.gov/state/seds/data.cfm?incfile=sep_sum/html/sum_btu_eu.html

Figure 2: Electricity Generation Fuel Shares for Washington and RGGI Covered States⁴⁷



Given the significant differences between the covered RGGI sector and that sector in Washington, there is limited value in considering the quantitative findings from RGGI. However, although some findings from RGGI are not likely to translate to a similar program in Washington, there still may be value in qualitatively understanding the results and highlighting lessons learned from the structure of the program and its evolution over time.

Several common themes and recommendations emerge from studies and analyses on RGGI. In particular, the original RGGI MOU required that, in 2012, the states conduct a comprehensive program review of their Emission Trading Programs through a regional stakeholder process that engaged not only the regulated community, but environmental nonprofits, consumer and industry advocates, and other interested stakeholders as well.⁴⁸ The recommendations below represent the most commonly identified best practices or lessons that should be taken from RGGI. These lessons are followed by a list of actions taken by RGGI States to address the findings.

Issues Identified

- There was a significant excess supply of allowances relative to actual emission levels in the region.

⁴⁷ Ibid.

⁴⁸ RGGI 2012 Program Review: Summary of Recommendations to Accompany Model Rule Amendments; http://www.rggi.org/docs/ProgramReview/FinalProgramReviewMaterials/Recommendations_Summary.pdf

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- Emissions have never approached the cap, peaking at 135 million tons in 2010 and dropping to 118 million tons in 2011. In 2012, with NJ dropping from the program, RGGI-covered emission levels hit a low of about 92 million⁴⁹.
- The current cost control measures in the program, which are based upon expansion of the percentage of offset allowances allowable for compliance, would likely be ineffective in controlling costs if the emissions cap is reached.

Programmatic Changes Incorporated as a Result of Findings⁵⁰

- The 2014 regional cap has been reduced from 165 million (already adjusted down from 188 million due to NJ's dropping out) to 91 million tons – roughly equivalent to 2012 emissions levels and a reduction of 45 percent of the previous cap. The cap will decline 2.5 percent each year from 2015 to 2020.
- The participating states will address the bank of excess allowances held by market participants with two interim adjustments for banked allowances.
- The participating states will establish a cost containment reserve (CCR), which is a reserved quantity of allowances, in addition to the cap, that would only be available if defined allowance price triggers were exceeded (\$4 in 2014, \$6 in 2015, \$8 in 2016, and \$10 in 2017, rising by 2.5 percent, to account for inflation, each year thereafter). Current auction prices have averaged \$2.33 over the course of the program.
- Covered entities must now retain enough allowances to cover at a minimum 50 percent of their emissions in any given year, and at the end of the compliance period must still surrender allowances to cover their emissions over the entire three-year period.
- The participating states do not intend to reoffer unsold 2012 and 2013 allocation year CO₂ allowances during the second control period.

The participating states will conduct ongoing program evaluation to continually improve RGGI. The participating states committed to commencing comprehensive program review no later than 2016.

3.1 GHG Impacts

To date, the RGGI GHG cap has far exceeded the emission levels of the covered electric power producers, making it unclear what portion of emission reductions since 2010 can be attributed to the program, and what portion has resulted from other factors. A New York State Energy Research and Development Authority analysis concluded that “...*three categories of factors are the primary drivers of the decreased CO₂... : 1) lower electricity load (due to weather; energy efficiency programs and customer-sited generation; and the economy); 2) fuel-switching from petroleum and coal to natural gas (due to relatively low natural gas prices); and 3) changes in*

⁴⁹ RGGI CO₂ Allowance Tracking System; <https://rggi-coats.org/eats/rggi/index.cfm?fuseaction=home.home&clearfuseattribs=true>

⁵⁰ RGGI 2012 Program Review: Summary of Recommendations to Accompany Model Rule Amendments; http://www.rggi.org/docs/ProgramReview/FinalProgramReviewMaterials/Recommendations_Summary.pdf

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available capacity mix (due to increased nuclear capacity availability and uprates; reduced available coal capacity; increased wind capacity; and increased use of hydro capacity)”.⁵¹

RGGI is credited with helping reduce electric load and increasing renewable capacity through its funding of renewable energy and energy efficiency programs.

RGGI rules require that a minimum 25 percent of auction revenues be spent by the states for consumer benefit or strategic energy purposes. In practice however, almost all of the revenues have been spent this way by the states. From a revenue utilization perspective, the program is therefore operating similarly to a public benefit fund (PBF) policy, where a transfer of funds occurs, usually from rate payers to the government, to fund projects for the public benefit. These projects typically include clean energy and energy efficiency. As the cap is lowered and its emission impacts become more apparent, the program will see a benefit from both the PBF aspect as well as cap driven reductions based on changes in generation fuel sources, increased conservation, and innovation in clean and efficient energy technologies.

Error! Reference source not found., below, summarizes some of the available GHG-related information for reductions associated with RGGI.

Table 5: GHG Costs and Benefits of the RGGI Cap and Trade Program

RGGI	
Cost of Reductions	<p>From September 2008 to June 2013, auction clearing prices have ranged from a low of \$1.86 to a high of \$3.51, with an average of \$2.35/mtCO₂e with cumulative proceeds totaling \$1.35 billion.⁵²</p> <p>According to the most recent RGGI investment report, which covers the entire first assessment period roughly 4.5 percent of the \$825.5 million total program proceeds went to program administration and RGGI Inc., 66 percent of revenue has been invested in energy efficiency, and 5 percent in renewable energy (of which over \$100 million is committed to future projects). The remaining goes to rate reductions, other municipal investments and state general funds. A total of about \$482 million has been invested in energy projects through the first compliance period.⁵³</p>
Volume of Reductions	<p>Total emissions from the capped electric sector were reduced 13 percent from 2009 to 2012, dropping 13.7 million mtCO₂e from 106.5 to 92.7 million mtCO₂e.⁵⁴</p> <p>Additionally, according to the 2011 RGGI Investment Report the revenue generated by the auctions has led to strategic energy projects, including energy efficiency throughout these states that will decrease emissions by 12 million mtCO₂e over the life of the projects.⁵⁵</p>

⁵¹ Environmental Defense Fund – “RGGI: The World’s Carbon Markets: A Case Study Guide to Emissions Trading”; http://www.ieta.org/assets/Reports/EmissionsTradingAroundTheWorld/edf_ieta_rggi_case_study_may_2013.pdf

⁵² http://www.rggi.org/market/co2_auctions/results

⁵³ RGGI 2011 Investment Report; <http://www.rggi.org/docs/Documents/2011-Investment-Report.pdf>

⁵⁴ RGGI CO₂ Allowance Tracking System; <https://rggi-coats.org/eats/rggi/index.cfm?fuseaction=home.home&clearfuseattribs=true>

⁵⁵ RGGI 2011 Investment Report; <http://www.rggi.org/docs/Documents/2011-Investment-Report.pdf>

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Programmatic Success	The program is generally considered a success in studies reviewed for this analysis, despite a misjudgment in setting the cap for the initial compliance period. The low cost of allowances has limited the impact on consumer electricity prices, and the states have been successful in effectively utilizing the funds to invest in energy efficiency and clean energy programs to reduce emissions. The reinvestment of allowance revenues by the states has been the most successful part of the program in reducing emissions.
Emissions Leakage	The general consensus is that leakage of emissions has not been a problem because of the overabundance of allowances and the low allowance cost. Because the updated Model Rule has called for lowering the cap, renewed focus on leakage has been required by the 2012 review, which includes looking for way to incorporate imported electricity into the program. ⁵⁶

3.2 Energy and Economic Impacts

There is limited information on RGGI's specific energy impacts because of the other drivers of change which occurred during the same timeframe as the program. A study published by the Analysis Group in November of 2011⁵⁷ on the economic impacts of RGGI's first compliance period, with a particular focus on the impact auction proceeds had on the states' economies, found that:

"RGGI produced \$1.6 billion in net present value economic value added to the ten-state region. The region's economy—and each state's as well—benefits from RGGI program expenditures. When spread across the region's population, these economic impacts amount to nearly \$33 per capita in the region."

Figure 3 was taken from the same referenced Analysis Group Report on the economic impact of the first compliance period (2009 -2011) for RGGI.

⁵⁶ Environmental Defense Fund – "RGGI: The World's Carbon Markets: A Case Study Guide to Emissions Trading"; http://www.ieta.org/assets/Reports/EmissionsTradingAroundTheWorld/edf_ieta_rggi_case_study_may_2013.pdf

⁵⁷ Analysis Group: "The Economic Impacts of the Regional Greenhouse Gas Initiative on Ten Northeast and Mid-Atlantic States"; http://www.analysisgroup.com/uploadedFiles/Publishing/Articles/Economic_Impact_RGGI_Report.pdf

Figure 3: Findings of Analysis Group Report (Graphic Excerpted from Analysis Group Report)**Summary of Economic Impacts, by RGGI State and Region Discounting Dollars Using a Social Discount Rate**

	Value Added ¹ (millions of \$)	Employment ²
Connecticut	\$ 189	1,309
Maine	92	918
Massachusetts	498	3,791
New Hampshire	17	458
Rhode Island	69	567
Vermont	22	195
New England Subtotal	\$ 888	7,237
New York	\$ 326	4,620
New York Subtotal	\$ 326	4,620
Delaware	\$ 63	535
Maryland	127	1,370
New Jersey	151	1,772
RGGI States in PJM Subtotal	\$ 341	3,676
Regional Impact ³	\$ 57	601
Grand Total	\$ 1,612	16,135

Notes:

[1] Value Added reflects the actual economic value added to the state and regional economies, and therefore does not include the costs of goods purchased from or manufactured outside of the state or region.

[2] Employment represents job-years as outputted from IMPLAN.

[3] Regional Impact reflects the indirect and induced impacts resulting within the RGGI region as a result of state dollar impacts.

[4] Results are discounted to 2011 dollars using a 3% social discount rate.

Additional economic impact data are summarized in **Error! Reference source not found.**

Table 6: Energy and Economic Impacts of the RGGI Cap and Trade Program

RGGI	
Independence from Fossil Fuels, and Economic Impact	Revenues from RGGI's first compliance period have contributed to in-state energy programs and projects that have led to a direct reduction of \$756 million in fuel expenditures that would have gone outside the region. ⁵⁸
Impacts on Fuel Choice	No specific impacts on fuel choice cited.
Opportunity for Investments in Infrastructure and Clean Energy/Energy Efficiency	Through the first compliance period of 2009-2011 around \$480 million of the over \$800 million collected from allowances has been reinvested in energy efficiency projects and clean and renewable energy technology development. RGGI provides case studies on a sample of these project types.

⁵⁸ RGGI Program Review News Release: RGGI States Propose Lowering Regional CO2 Emissions Cap 45%, Implementing a More Flexible Cost-Control Mechanism;
http://www.rggi.org/docs/PressReleases/PR130207_ModelRule.pdf

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Impact on Different Sectors of the Economy	While the overall long run cost to power plant owners between 2008 and 2011 is estimated at \$1.6 billion, mostly attributable to lower sales as a result of induced energy efficiency. ⁵⁹ However according to EDF, “The allocation of RGGI proceeds to several types of programs leads to more purchases of goods and services (for example, engineering services for energy audits, energy efficiency equipment, labor for installing solar panels, etc.) that provide an economic stimulus.” ⁶⁰
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3.3 Household Impacts and Co-Benefits

Several studies indicated that the cost of carbon allowances (which remains low) was successfully passed on to the consumers. However, due to the overall reduced consumption due to efficiency projects and general rate relief provided by the state with a portion of the RGGI funds, studies also indicated that consumers are expected to save money overall due to the program in the long term. **Error! Reference source not found.**, below, summarizes the available household impact and co-benefit information for the RGGI program.

Table 7: Household Impacts and Co-Benefits of the RGGI Cap and Trade Program

RGGI	
Effect on Household Consumption and Spending	Households in the RGGI region recognized a nearly \$1.1 billion net gain due to improvements in energy efficiency resulting from RGGI revenues. In addition, according to EDF: ⁶¹
Measures to Mitigate to Low-income Populations, or Economic Impact	Through 2011, over \$86 million of the collected program funds have gone to low income rate relief and low income energy efficiency improvement programs to reduce energy bills and mitigate any price increases from RGGI. Another \$37 million has gone to general rate relief, which may also impact low-income populations. ⁶² According to the EDF: “RGGI funds were used to protect customers from electricity price increases and were invested into energy efficiency. Consumers end up gaining from these investments because their overall electricity bills go down as a result of improvements in energy efficiency.” ⁶³
Significant Co-benefits	None quantified.

⁵⁹ Analysis Group: “The Economic Impacts of the Regional Greenhouse Gas Initiative on Ten Northeast and Mid-Atlantic States”; http://www.analysisgroup.com/uploadedFiles/Publishing/Articles/Economic_Impact_RGGI_Report.pdf

⁶⁰ Environmental Defense Fund – “RGGI: The World’s Carbon Markets: A Case Study Guide to Emissions Trading”; http://www.ieta.org/assets/Reports/EmissionsTradingAroundTheWorld/edf_ieta_rggi_case_study_may_2013.pdf

⁶¹ Analysis Group’s November 2011 Report; http://www.analysisgroup.com/uploadedFiles/Publishing/Articles/Economic_Impact_RGGI_Report.pdf

⁶² RGGI 2011 Investment Report; <http://www.rggi.org/docs/Documents/2011-Investment-Report.pdf>

⁶³ Environmental Defense Fund – “RGGI: The World’s Carbon Markets: A Case Study Guide to Emissions Trading”; http://www.ieta.org/assets/Reports/EmissionsTradingAroundTheWorld/edf_ieta_rggi_case_study_may_2013.pdf

4 European Union Emissions Trading Scheme (EU ETS)

Policy Definition	Targeted Sector or Emissions
Launched in 2005, the European Union Emission Trading Scheme (EU ETS) operates in all 28 EU countries as well as Iceland, Liechtenstein and Norway, covering sectors that are responsible for approximately 45 percent of total GHG emissions. It places a cap on covered GHG emissions, and allows trading among regulated industry.	Economy-wide (power plants, a wide range of energy-intensive industry sectors and commercial airlines.)
GHGs and Costs	
<ul style="list-style-type: none"> Emissions in the sectors covered by the ETS declined from 2005 to the end of 2010 by more than 13 percent. Studies give a range of approximately 2–5 percent below estimated emissions levels in the absence of the program, which equates to 120 million to 300 million tons. Estimates place the total cost at less than 1 percent of the European Union’s GDP as low as 0.01 percent of the EU’s GDP⁶⁴ 	
Implementation Issues and Lessons Learned	
<p>EU ETS provides important lessons learned for any cap and trade program, most importantly as they relate to the following areas which detailed in write up below.</p> <ul style="list-style-type: none"> Measuring Success and Impacts Setting an appropriate emissions cap Allocation methods and considerations Offsets, linking with other programs, and price containment 	
Costs and Benefits to Consumers	Costs and Benefits to Businesses
<ul style="list-style-type: none"> Health benefits of improved air quality if the EU ETS tightened its 2020 cap would be in the range of \$4.3 billion to \$10.4 billion.⁶⁴ Several covered sectors have successfully passed on the cost of allowance to consumers by raising prices. European Commission estimated that the EU would save an average of \$26 billion (€20 billion) in fuel costs each year from 2016 to 2020. 	<ul style="list-style-type: none"> Lime, cement, basic iron and steel, pulp and paper, and power sectors are the most at risk for increased costs and negative employment impacts. There has been a lack of innovation as a result of the EU ETS. This lack is assumed to be due to the fact that the carbon market established an insufficient price signal. Leakage of emissions and competitive advantages from covered sectors or countries to uncovered sectors or countries has not been an issue due to free allocations of allowances for at risk sectors and country policies, i.e. reimbursement for indirect costs of compliance. According to the Carbon Trust total leakage by 2020 is unlikely to exceed 1% of EU Emissions.⁶⁵

Launched in 2005, the European Union Emission Trading Scheme (EU ETS) operates in all 28 EU countries as well as Iceland, Liechtenstein and Norway, covering sectors that are responsible for approximately 45 percent of total GHG emissions in those countries. The first phase was set

⁶⁴ European Commission Staff Working Paper, “Analysis of options beyond 20% GHG emission reduction: Member State results,” January 30, 2012; http://ec.europa.eu/clima/news/articles/news_2012013002_en.htm

⁶⁵ Carbon Trust - EU ETS Impact on Profitability and Trade; <http://www.carbontrust.com/media/84892/ctc728-euets-impacts-profitability-and-trade.pdf>

up to be experimental to help develop the market and lasted from 2005 through 2007. The second phase went from 2008 through 2012. The third phase of the EU ETS runs from 2013-2020, and aims to lower emissions from covered sectors by 21 percent from 2005 levels by 2020.⁶⁶ The third phase includes some significant program changes. The scope of the EU ETS will be expanded to include additional sectors and gases, and an overall EU cap will be used instead of individual member state set caps.⁶⁷ The default allocation method in the third phase will be auctions, though there will continue to be free allocation to manufacturing⁶⁸ and industries identified as at risk of leakage.⁶⁹ The EU ETS market has historically utilized the Clean Development Mechanism (CDM) and Joint Implementation (JI) to generate and obtain international offsets from developing and developed nations. In addition, the EU is pursuing sector-based offset crediting through a new market mechanism.⁷⁰ Finally, the EU ETS is pursuing linkage with the Australian cap and trade system, beginning in 2015.⁷¹

The EU ETS represents the largest, most studied GHG cap and trade system, and it has faced significant challenges and criticisms during its existence, including debates over offset eligibility, over-allocation, and backloading. This analysis will summarize some of the existing analyses, but focus on eliciting lessons learned from the program's history in terms of the overall design and implementation.

Several common themes and recommendations are apparent after reviewing the multiple studies and analyses on the EU ETS. These should be carefully examined and evaluated when designing any type of cap and trade or market based reduction program. The recommendations below were taken directly from several of the studies reviewed and represent the most commonly identified lessons that should be taken from the EU ETS.

Measuring Success and Impacts

- The European Commission said that data limitations preclude definitive conclusions about the ETS's effect during Phase I. Current literature and studies are inconclusive because the EU ETS was not designed with a monitoring framework in mind, as Phase 1 was expected to be a trial and error process. A monitoring framework should be part of the initial design and in place from the beginning.⁷²

⁶⁶ European Commission. July 2013. The EU Emissions Trading System (EU ETS). Accessed July 2013 at: http://ec.europa.eu/clima/policies/ets/index_en.htm

⁶⁷ http://www.edf.org/sites/default/files/EU_ETS_Lessons_Learned_Report_EDF.pdf

⁶⁸ European Commission. January 2013. Free allocation based on benchmarks. Accessed July 2013 at: http://ec.europa.eu/clima/policies/ets/cap/allocation/index_en.htm

⁶⁹ European Commission. January 2013. Carbon leakage. Accessed July 2013 at: http://ec.europa.eu/clima/policies/ets/cap/leakage/index_en.htm

⁷⁰ European Commission. January 2013. International carbon market. Accessed July 2013 at: http://ec.europa.eu/clima/policies/ets/linking/index_en.htm

⁷¹ European Commission. August 2012. Australia and European Commission agree on pathway towards fully linking emissions trading systems. Accessed July 2013 at: http://ec.europa.eu/clima/news/articles/news_2012082801_en.htm

⁷² U.S. Government Accountability Office (GAO), 2008 report - Lessons Learned from the European Union's Emissions Trading Scheme and the Kyoto Protocol's Clean Development Mechanism.; <http://www.gao.gov/new.items/d09151.pdf>

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- Over-allocation of allowances has posed challenges in assessing the program's long-term economic impacts. Key questions still remain as a result, (i) how tight a cap should be set in going forward to deliver a price point on emission allowance that will provide the desired level of emission abatement, and (ii) what consequences does this cap have for economic growth and competitiveness?⁷³
- Even with much higher carbon price expectations than the market delivered, only a small fraction of businesses expected downsizing or relocation due to these climate based policies, showing that negative impacts to employment and competition might not be significant, even with prices up to €40.⁸

Setting the Cap

- Accurate current and historical emissions data are essential to setting the right emissions cap.⁷
- Emissions caps and resulting allowance allocations should be based on measured and verified historical emissions, rather than on estimated or projected emissions.⁷⁴
- There has been an observed lack of innovation in clean energy and energy efficiency as a result of the EU ETS, which is consistent with the common view that the carbon market established an insufficient price signal to induce innovation.⁸
- The cap should be ambitious to encourage businesses to think creatively about reducing GHG emissions and spur innovation.⁹
- The EU ETS can, and should, continue with deeper emission cutbacks post-2012, as this is not expected to damage European competitiveness overall.⁷⁵
- A trading program should provide enough certainty and should cover a long enough time period to influence technology investment decisions.⁷⁶
- The best way to stimulate long-term emission reduction investments is by maintaining a predictably declining, enforceable, science-based cap on carbon. There should also be a mechanism to decouple emissions growth from economic growth.⁷⁷

Allocation

- The method for allocating allowances will have important economic effects.¹¹

⁷³ UK Government Dept. of Energy and Climate Change; https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48449/5725-an-evidence-review-of-the-eu-emissions-trading-sys.pdf

⁷⁴ Environmental Defense Fund - "The EU Emissions Trading System, Results and Lessons Learned"; http://www.edf.org/sites/default/files/EU_ETC_Lessons_Learned_Report_EDF.pdf

⁷⁵ Carbon Trust - EU ETS Impact on Profitability and Trade; <http://www.carbontrust.com/media/84892/ctc728-euets-impacts-profitability-and-trade.pdf>

⁷⁶ U.S. Government Accountability Office (GAO), 2008 report - Lessons Learned from the European Union's Emissions Trading Scheme and the Kyoto Protocol's Clean Development Mechanism; <http://www.gao.gov/new.items/d09151.pdf>

⁷⁷ Environmental Defense Fund - "The EU Emissions Trading System, Results and Lessons Learned"; http://www.edf.org/sites/default/files/EU_ETC_Lessons_Learned_Report_EDF.pdf

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- The windfall profits that occurred in some member states can be avoided using a variety of policy tools. There should be appropriate regulatory oversight of public utilities, and auction some or all allowances.¹²
- Several studies summarized by the U.K. Department of Energy and Climate Change concluded that free allocation may have a negative effect on both the environmental and cost effectiveness of the EU ETS. Reducing free allocation would therefore appear to be a good policy objective in going forward, without losing sight of the key objective of free allocation to mitigate the risk of carbon leakage and job losses.⁷⁸
- The extent and pace at which free allocations are reduced should differ between sectors according to their degree of cost and trade exposure.¹⁰

Offsets, Linking, and Price Containment

- Offsets provide a way for covered sectors to meet their targets that may cost less than reducing their own emissions, however (1) the resources necessary to obtain offset project approval may reduce the cost-effectiveness and quality of projects; (2) the need to ensure the credibility of offset reductions presents a significant regulatory challenge; and (3) due to the tradeoffs with offsets, the use of such programs may be, at best, a temporary solution.¹¹
- It must be ensured that offset programs have rigorous monitoring and accounting methodologies to certify that emission reductions are “additional”.¹²
- Reforms should be adopted that allow offset credits only from jurisdictions that have capped some portion of their emissions.¹²
- If allowance banking from year-to-year is allowed to help firms minimize cost and increase flexibility over time, the program must provide a predictable long-term policy environment that allows for this to occur and be incorporated into planning.¹² There were studies that had sharp criticisms of banking allowances as part of the program, so this should be carefully considered.
- If linking to other emissions trading programs, do so preferentially with those that adopt caps or limits on major emitting sectors.⁷⁹

Effective governance and regulatory bodies are necessary to prevent tax fraud and theft.¹⁴

4.1 GHG Impacts

Because GHG reductions are predetermined with the setting of the emissions cap, it is often assumed that assessing the GHG impacts of the program would be simple. However, because of the economic downturn and other unrelated factors, there has been considerable debate over what portion of the EU’s emission reductions since 2005 can be attributed to the EU ETS. **Error!**

⁷⁸ UK Government Dept. of Energy and Climate Change; https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48449/5725-an-evidence-review-of-the-eu-emissions-trading-sys.pdf

⁷⁹ Environmental Defense Fund - "The EU Emissions Trading System, Results and Lessons Learned"; http://www.edf.org/sites/default/files/EU_ETTS_Lessons_Learned_Report_EDF.pdf

reference source not found., below, summarizes some of the available GHG-related information for Phase I and Phase II of the EU ETS.

Table 8: GHG Costs and Benefits of the EU ETS Cap and Trade Program

EU ETS	
Cost of Reductions	There is little or no information on the operational cost of the EU ETS, however the economic cost of reductions to the member nations has been much smaller than expected. Most estimates place the total cost at less than 1 percent of the European Union's GDP as low as 0.01 percent of the EU's GDP ¹⁴ . Several studies claim that if all allowances were auctioned, rather than freely allocated, there would be no economic cost and could potentially see significant economic gains. ⁸⁰ Allowances on the EU market have traded at a high of €32 in 2006 and at prices near zero when the price crashed during the in 2007, but rebounded to trade back over €30 in 2008. ⁸¹ Currently prices are trading slightly above €4.
Volume of Reductions	Emissions in the sectors covered by the ETS declined from 2005 to the end of 2010 by more than 13 percent. By 2009, the EU's 27 member states saw GHG emissions decrease by 17 percent relative to 1990 levels, while GDP grew by more than 40 percent. ¹⁴ There are differing views on the level of reductions that the EU ETS is responsible for. Several studies found that emissions across all regulated sectors declined by around 3 percent in Phase I and during the first two years of Phase II. ¹⁵ Other studies are less specific giving a range of approximately 2–5 percent below estimated emissions levels in the absence of the program, which equates to 120 million to 300 million tons. ¹⁴ A study by New Energy Finance indicates that <i>"the ETS was responsible for 40 percent of the 3 percent reduction in emissions in the EU in 2008, the first year of the ETS's post-pilot Phase II, with the recession accounting for only about 30 percent of the observed reductions. More recent research indicates that these trends continued beyond 2008. In 2009 alone, for example, the ETS was likely responsible for more than 230 million tons of CO₂ reductions."</i> ¹⁴
Programmatic Success	As the first GHG cap and trade scheme, the EU ETS has been successful in discovering and addressing several design issues. Through trial and error the program has faced and addressed numerous problems and given insight and lessons learned to other programs around the world. This continues today as the EU ETS attempts to backload 900 million allowances to address over-allocation and add the aviation sector to the program. Success in reducing emissions has been superseded by emission reductions due to economic decline and the lower cost of natural gas relative to coal. Because of over allocation and low allowance prices the economic impact has been minimal, but this has also led to unintended windfall profits for some sectors and created uncertainty in the market limiting the overall effectiveness of the program compared to initial expectations.

⁸⁰ UK Government Dept. of Energy and Climate Change;

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48449/5725-an-evidence-review-of-the-eu-emissions-trading-sys.pdf

⁸¹ <http://www.theguardian.com/environment/2013/jan/24/eu-carbon-price-crash-record-low>

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Emissions Leakage	According to most studies, leakage of emissions from covered sectors or countries to uncovered sectors or countries has not been an issue due to design elements such as free allocations of allowances for at risk sectors and individual country policies, such as the U.K.'s reimbursement policy for indirect costs of compliance. According to the Carbon Trust total leakage by 2020 is unlikely to exceed 1 percent of EU Emissions. ⁸²
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While the majority of the existing studies on the GHG impacts of the EU ETS do seem to indicate it was responsible for a significant portion of the reductions seen in the EU, the empirical evidence gathered by surveying many of the covered firms across different countries in the EU suggests otherwise. Very few of the surveyed firms in any sector or country credited the EU ETS as being the main driver in reducing emissions.⁸³

4.2 Energy and Economic Impacts

There is limited information on the energy and economic impacts of the EU ETS. Current literature and studies are inconclusive about these impacts, although some general insights are expressed in **Error! Reference source not found.**

Table 9: Energy and Economic Impacts of the EU ETS Cap and Trade Program

EU ETS	
Independence from Fossil Fuels, and Economic Impact	A recent report by the European Commission estimated that the EU would save an average of \$26 billion (€20 billion) in fuel costs each year from 2016 to 2020. ⁸⁴
Impacts on Fuel Choice	There is no evidence so far that links the realized emission reductions from the program to specific mechanisms. For example, whether abatement has been achieved by switching fuels or by installing a more efficient technology cannot yet be answered. This is because large, country-specific data sets that compare covered firms with non-covered firms in the same high energy intensive sectors are not available. ⁸⁵ Simply comparing high-level fuel consumption at the country level may show changes in fuel choice, but those cannot be credited to the EU ETS without more rigorous analysis. Some studies attempted to compare covered sectors with non-covered “control” sectors, but because the covered sectors are energy intensive and the non-covered sectors tend not to be, the results were inconclusive.

⁸² Carbon Trust - EU ETS Impact on Profitability and Trade; <http://www.carbontrust.com/media/84892/ctc728-euets-impacts-profitability-and-trade.pdf>

⁸³ UK Government Dept. of Energy and Climate Change; https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48449/5725-an-evidence-review-of-the-eu-emissions-trading-sys.pdf

⁸⁴ Environmental Defense Fund - "The EU Emissions Trading System, Results and Lessons Learned"; http://www.edf.org/sites/default/files/EU_ETS_Lessons_Learned_Report_EDF.pdf

⁸⁵ UK Government Dept. of Energy and Climate Change; https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48449/5725-an-evidence-review-of-the-eu-emissions-trading-sys.pdf

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Opportunity for Investments in Infrastructure and Clean Energy/Energy Efficiency	There has been a lack of innovation as a result of the EU ETS. This lack is assumed to be due to the fact that the carbon market established an insufficient price signal, and that a higher carbon price is required for inducing innovation. However, there may be other factors that limited innovation for new energy technologies other than the low price of carbon allowances. There was some evidence of carbon abatement technology adoption which was more compelling than evidence on genuine innovation of new technologies or methods. ⁸⁶
Impact on Different Sectors of the Economy	Studies showed conflicting results of the effects on company profits and employment. One U.K. study identified lime, cement, basic iron, and steel as industrial activities that are more carbon-cost-sensitive and at risk. However, these industries comprise only a small percent of the economy and overall employment. Generally, the EU ETS has accounted for at risk sectors by providing free emission allowances. ⁸⁷ The EDF cited several reports confirming that the cost impacts to the power, iron and steel, and pulp and paper industries would be minimal, the highest being a small segment of the pulp and paper industry which could see a 3 percent to 6 percent cost increase. ⁸⁸

The EU ETS has been criticized for the windfall profits of companies who passed on the price of carbon to customers even though their allowances were obtained for free,⁸⁹ but there was little evidence that the EU ETS had an adverse effect on the international competitiveness of regulated firms. Nonetheless, EU ETS covered firms had a slightly higher probability to downsize in response to carbon pricing than non-covered firms.⁹⁰

A study done by Carbon Trust showed that overall, the EU ETS can afford to make more drastic cutbacks in Phase III without damaging U.K. or European competitiveness overall. The study found that some key sectors will require policy intervention to avoid more significant impacts. The study found that the production of lime, cement, basic iron and Steel as stand out industrial activities that are far more carbon-cost-sensitive. However these at risk sectors in the U.K. only comprise about 0.2 percent of the economy and 0.1 percent of employment, but may be more significant in other countries. The EU ETS has accounted for these at risk sectors by providing

⁸⁶ UK Government Dept. of Energy and Climate Change; https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48449/5725-an-evidence-review-of-the-eu-emissions-trading-sys.pdf

⁸⁷ Carbon Trust - EU ETS Impact on Profitability and Trade; <http://www.carbontrust.com/media/84892/ctc728-euets-impacts-profitability-and-trade.pdf>

⁸⁸ Environmental Defense Fund - "The EU Emissions Trading System, Results and Lessons Learned"; http://www.edf.org/sites/default/files/EU_ETTS_Lessons_Learned_Report_EDF.pdf

⁸⁹ Environmental Defense Fund - "The EU Emissions Trading System, Results and Lessons Learned"; http://www.edf.org/sites/default/files/EU_ETTS_Lessons_Learned_Report_EDF.pdf

⁹⁰ UK Government Dept. of Energy and Climate Change; https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48449/5725-an-evidence-review-of-the-eu-emissions-trading-sys.pdf

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free allocation of emission allowances, but this does not necessarily prevent trade effects in the future.⁹¹

One literature review that summarized multiple studies concluded that there were ambiguous results from testing the premise that the EU ETS weakened net exports of goods from covered countries into non-regulated countries. There was also evidence that a number of sectors were able to pass through the costs of emission permits on to final product markets.⁹²

4.3 Household Impacts and Co-Benefits

There are no direct impacts on households as a result of the EU ETS, as they are not covered under the regime. However many studies found that the cost of carbon allowances (which remains low) was successfully passed on to the consumers in many sectors.⁹³ **Error! Reference source not found.**, below, summarizes the available household impact and co-benefit information for the EU ETS program.

Table 10: Household Impacts and Co-Benefits of the EU ETS Cap and Trade Program

EU ETS	
Effect on Household Consumption and Spending	Studies qualitatively discussed the fact that several sectors successfully passed on allowance costs to consumers, but did not provide quantitative impact analysis. ^{92,94}
Measures to Mitigate to Low-income Populations, or Economic Impact	None noted
Significant Co-benefits	A recent report by the European Commission estimated that the health benefits of improved air quality if the EU ETS tightened its 2020 cap would be in the range of \$4.3 billion to \$10.4 billion. ^{95,93}

⁹¹ Carbon Trust - EU ETS Impact on Profitability and Trade; <http://www.carbontrust.com/media/84892/ctc728-euets-impacts-profitability-and-trade.pdf>

⁹² UK Government Dept. of Energy and Climate Change; https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48449/5725-an-evidence-review-of-the-eu-emissions-trading-sys.pdf

⁹³ UK Government Dept. of Energy and Climate Change; https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48449/5725-an-evidence-review-of-the-eu-emissions-trading-sys.pdf

⁹⁴ Environmental Defense Fund - "The EU Emissions Trading System, Results and Lessons Learned"; http://www.edf.org/sites/default/files/EU_ETTS_Lessons_Learned_Report_EDF.pdf

⁹⁵ European Commission Staff Working Paper, "Analysis of options beyond 20% GHG emission reduction: Member State results," January 30, 2012; http://ec.europa.eu/clima/news/articles/news_2012013002_en.htm

5 New Zealand Emissions Trading Scheme

Policy Definition	Targeted Sector or Emissions
The New Zealand Emissions Trading Scheme (ETS) is the system in which New Zealand Units (NZUs) are traded. Under the ETS, certain sectors are required to acquire and surrender NZUs or other eligible emission units to account for their direct GHG emissions or the emissions associated with their products.	Covers forestry, energy, fishing, industry, liquid fossil fuels, synthetic gases, and waste. The agriculture sector was originally scheduled to enter the scheme in January 2015, but this date has been pushed back.
GHGs and Costs	
<ul style="list-style-type: none"> An estimate of emissions from 1990 to 2050 was calculated as part of the Trading Scheme Review in 2011 and showed that New Zealand was on track to meet their 2008 – 2015 target of remaining at 1990 emission levels (1990 emissions were 59.8 MMTCO₂e). The projections show emissions at slightly above 1990 levels in 2020, which is not on track to meet the countries stated goal of 10 to 20 percent below 1990 levels in this year. The estimates show large swings in net emissions after 2020, largely due to land use change in the forestry sector. The ETS includes a fixed price cap of NZ\$25 (US\$20.14) per NZU. Combined with the “one-for-two” surrender obligation, where entities are required to surrender only one NZU for every two mtCO₂e, this results in an effective maximum emissions price of NZ\$12.50 (US\$10.07) per metric ton. 	
Implementation Issues and Lessons Learned	
<ul style="list-style-type: none"> The NZ ETS has come under fire recently as it allows international Emission Reduction Units (ERUs) in uncapped amounts to be used to offset government issued emission allowances (NZUs). NZUs have dropped from about NZ\$20 (US\$16) in 2011 to about NZ\$2 (US\$1.61) in early 2013, largely because participants can cover their emissions with an unlimited number of inexpensive international offsets. Transitional measures to limit price exposure originally designed to be temporary have been extended indefinitely and include a price cap, one-for-two surrender obligation, free allocation of NZUs, and offsetting for the forestry sector. 	
Costs and Benefits to Consumers	Costs and Benefits to Businesses
<ul style="list-style-type: none"> The Reserve Bank of New Zealand (RBNZ) estimated that under the NZ ETS prices of fuel and electricity would rise by between 3 and 8 percent, increasing consumer price index (CPI) inflation by 0.3 percent. Inclusion of the industrial processing sector in the scheme was not expected to have a noticeable impact on consumer prices. 	<ul style="list-style-type: none"> Expected impact on total business expenditures of NZ\$465 million (US\$374.65), or 0.3 percent, of GDP in 2013 and NZ\$702 million (US\$565.60), or 0.4 percent GDP, in 2015 Expected impact on GDP of -0.1 to -1.0 percent of 2020 level, depending on the scenario modeled.

Launched in 2008, the New Zealand Emissions Trading Scheme (NZ ETS) covers all six Kyoto gases, and like the California scheme, progressively covers more sectors, with an aim of including all sectors by 2015. Forestry was the first sector included in the scheme in January 2008. The liquid fossil fuels, stationary energy, and industrial processes sectors joined in July 2010 and the waste and synthetic GHG sectors joined in January 2013. The agriculture sector was originally scheduled to enter the scheme in January 2015. This date has been pushed back until the New Zealand Parliament determines that sufficient technologies are available to reduce

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emissions in the sector and that international competitors are taking sufficient action on their agriculture emissions.⁹⁶ Participants in the agriculture sector are still required to report their emissions.

Under the mandatory ETS, compliance entities are required to obtain and surrender New Zealand Units (NZUs), or other eligible units including international emission units, to account for their direct GHG emissions or the emissions associated with their products. The NZ ETS provides for the transitional free allocation of NZUs to the agriculture sector and certain trade-exposed emission intensive industrial sectors.⁹⁷ The original aim of the NZ ETS was to have full auctioning by all sectors in 2013; however, the allocation of a limited number of free NZUs was extended through amendments in 2012.

The NZ ETS is currently operating as a non-binding cap within the country's overarching global agreement under the Kyoto Protocol. Under the Protocol, New Zealand had a legally binding target to maintain average annual emissions at 1990 levels (59.6 MMTCO₂e⁹⁸) in the period from 2008 to 2012⁹⁹, which they met with a surplus of units. Subsequently, New Zealand did not sign on for a second commitment period under the Kyoto Protocol, instead choosing a non-binding pledge for emission reductions under the Convention Framework.¹⁰⁰ The country has pledged to reduce emissions between 10 percent and 20 percent below 1990 levels by 2020 and, in March 2011, announced a reduction target of 50 percent below 1990 levels by 2050.¹⁰¹

One interesting design element of the NZ ETS is that it covers the upstream entities associated with the electricity sector, such as producers and importers of coal and natural gas, as opposed to downstream entities such as electricity generators. It is assumed that the costs of the ETS obligations are passed on to the downstream entities. However, there is a voluntary opt-in mechanism which allows downstream entities to take on the mandatory participant's ETS obligation. For example, an electricity generator that uses coal can choose to take on the surrender obligation of the mining company that it buys its coal from.

The New Zealand government opted for a price-based mechanism for reducing emissions, primarily because it provides flexibility and can be linked to international GHG reduction efforts. The government decided against an emissions tax because it would have required regular

⁹⁶ New Zealand Ministry of the Environment. April 2013. Agriculture in the Emissions Trading Scheme. <http://www.climatechange.govt.nz/emissions-trading-scheme/participating/agriculture/>

⁹⁷ New Zealand Ministry of the Environment. Allocation in the New Zealand Emissions Trading Scheme. <http://www.mfe.govt.nz/publications/climate/allocation-nz-ets-dec07/allocation-nz-ets-dec07.html>

⁹⁸ New Zealand Ministry of the Environment. April 2013. New Zealand's Greenhouse Gas Inventory 1990–2011 and Net Position. <http://www.mfe.govt.nz/publications/climate/greenhouse-gas-inventory-2013-snapshot/index.html>

⁹⁹ United Nations Framework Convention on Climate Change. Kyoto Protocol. Targets for the first commitment period. http://unfccc.int/kyoto_protocol/items/3145.php

¹⁰⁰ New Zealand Ministry of the Environment. The Kyoto Protocol. <http://www.mfe.govt.nz/issues/climate/international/kyoto-protocol.html>

¹⁰¹ New Zealand Ministry of the Environment. Reducing Our Emissions. April 2011. <http://www.climatechange.govt.nz/reducing-our-emissions/targets.html>

alteration to ensure its effectiveness and to keep it in line with international emissions prices. An ETS was chosen as the preferred mechanism for the reasons outlined below. The following points are taken directly from The Framework for a New Zealand Emissions Trading Scheme, prepared in 2007:¹⁰²

- An ETS provides the government with relative certainty about the volume of emissions, and hence the environmental objectives, whereas a tax simply imposes a price on each unit of emissions and does not limit emissions per se
- An ETS is easily linked into the international emissions price and global emission reduction efforts, which minimizes the risk to the New Zealand taxpayer of overshooting or undershooting our Kyoto Protocol and future international commitments
- An ETS provides New Zealand firms with maximum flexibility through enabling them to reduce or offset their emissions (including managing credits and liabilities over time) by accessing emission reduction opportunities at the lowest cost
- An ETS has wide support, being preferred as the primary means of managing New Zealand's emissions in the long term by many submitters on the five discussion documents released in December 2006
- An ETS allows New Zealand to devolve forest credits and liabilities to landowners as part of a broader economic instrument
- An ETS is emerging as the favored measure among developed countries, and early adoption by New Zealand would bring significant benefits

5.1 GHG Impacts

A comprehensive review of the NZ ETS was completed in June 2011 by a government-appointed panel. The review provides an estimate of the net and gross GHG emissions with and without the ETS from 1990–2050. Gross emissions do not include CO₂ sequestration, making net emissions an important measure for New Zealand because the country relies heavily on the forestry sector to act as a carbon sink, which reduces net emissions. Figure 4 presents the country's estimate of net and gross emissions, with and without the ETS, from 1990 to 2050. The figure shows that the country met its goals under the first Kyoto commitment period (2008 – 2015), and shows the challenge the country faces in meeting its 2050 reduction targets.

¹⁰² The Framework for a New Zealand Emissions Trading Scheme. September 2007.
<http://www.mfe.govt.nz/publications/climate/framework-emissions-trading-scheme-sep07/framework-emissions-trading-scheme-sep07.pdf>

Figure 4: New Zealand’s net and gross GHG emissions with and without ETS, 1990–2050
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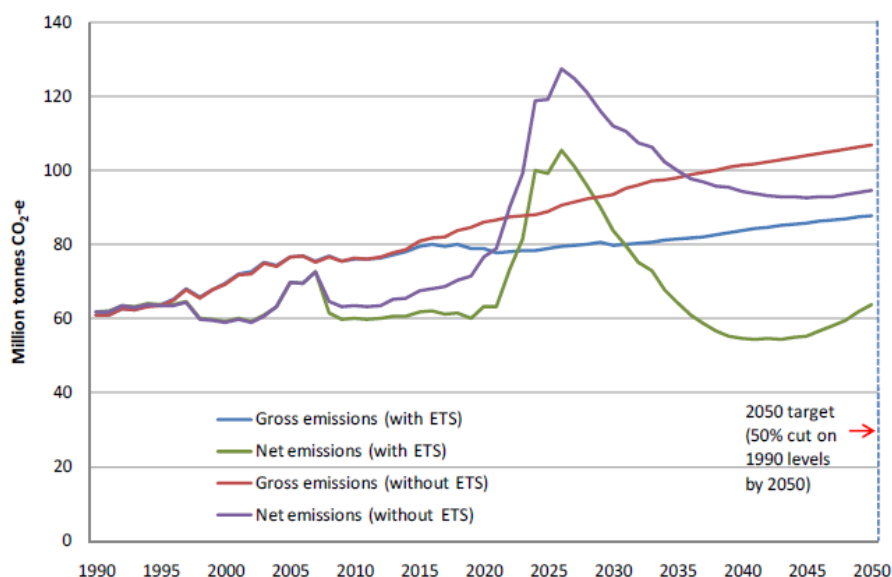


Table 11 summarizes additional GHG related information for the NZ ETS.

Table 11: GHG Costs and Benefits of NZ ETS

New Zealand Emissions Trading Scheme	
Cost of Reductions	<p>The ETS includes fixed price cap of NZ\$25 (US\$20.14) per NZU. Combined with the “one-for-two” surrender obligation, where entities are required to surrender only one NZU for every two mtCO₂e, this results in an effective maximum emissions price of NZ\$12.50 (US\$10.07) per tonne.¹⁰⁴</p> <p>NZUs have dropped from about NZ\$20 (US\$16) in 2011 to about NZ\$2 (US\$1.61) in early 2013, largely because participants can cover their emissions with an unlimited number of inexpensive international offsets.¹⁰⁵</p>

¹⁰³ Emissions Trading Scheme Review Panel. 2011. Doing New Zealand’s Fair Share. Emissions Trading Scheme Review 2011: Final Report. Wellington: Ministry for the Environment. <http://www.climatechange.govt.nz/emissions-trading-scheme/ets-review-2011/>

¹⁰⁴ Ibid.

¹⁰⁵ Thomson Reuters Point Carbon, Carbon Market Australia – New Zealand, Vol 6, issue 2, 1 March 2013. http://www.pointcarbon.com/polopoly_fs/1.2202614!CMANZ20130301.pdf.

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Volume of Reductions	An estimate of emissions from 1990 to 2050 was calculated as part of the Trading Scheme Review in 2011 and showed that New Zealand was on track to meet their 2008 – 2015 target of remaining at 1990 emission levels. However, the projections show emissions at slightly above 1990 levels in 2020, which is not on track to meet the countries stated goal of 10 to 20 percent below 1990 levels in this year. The estimates show large swings in net emissions after 2020, largely due to land use change in the forestry sector. However, emissions in 2035 and 2050 were projected to be close to 1990 levels. See Figure 1, above.
Programmatic Status	While it is still early, the NZ ETS has generally been considered successful, and has imposed minimal impacts on regulated entities and households.
Emissions Leakage	Carbon sequestration in forests is expected to play a large role in reducing emissions under the ETS. However, stakeholders noted that forestry reductions are not a long term solution for meeting targets, particularly if forests are harvested in the future. Therefore, stakeholder noted that the introduction of abatement measures to reduce gross emissions must also be included. ¹⁰⁶

The panel that prepared the Trading Scheme Review 2011 conducted extensive discussions with ETS participants as well as industry and community stakeholders and identified several key themes surrounding the review and future of the NZ ETS. Three overarching themes were identified from stakeholder input:¹⁰⁷

Too early to assess full impact – At the time of the review several sectors had not yet joined the scheme, including agriculture, the country’s largest emission source, and therefore stakeholders felt that it was too early to effectively assess the full impact of the ETS.

Impacts of ETS have been low for most – The general impression from stakeholders was that at the time of the review, the impact of the ETS was generally low for most submitters. Stakeholders cited transitional measures, free allocation of NZUs, and the short period of time that some sectors have faced obligations as reasons for the low impact. However, the impact was not uniform, with some businesses reporting costs that were higher than average. The panel also found that low income households were disproportionately affected by costs passed through the ETS in energy bills.

Uncertainty and unpredictability – Stakeholders voiced concern over the uncertainty of several aspects of the ETS, including the future of the international GHG framework under the

¹⁰⁶ Emissions Trading Scheme Review Panel. 2011. Doing New Zealand’s Fair Share. Emissions Trading Scheme Review 2011: Final Report. Wellington: Ministry for the Environment. <http://www.climatechange.govt.nz/emissions-trading-scheme/ets-review-2011/>

¹⁰⁷ Ibid.

Kyoto Protocol, the uncertainty of whether the transitional measures would end, and the unpredictability of international carbon markets and future carbon prices.

The panel also asked stakeholders their opinion of how the ETS was operating in terms of administrative efficiency, compliance costs, penalties, and general organization. Stakeholders reported few concerns in relation to the administration of the ETS and in general reported that it was running well and that there were no over burdensome transaction costs.

5.2 Energy and Economic Impacts

Table 12 summarizes additional available energy and economic impacts of the NZ ETS.

Table 12: Energy and Economic Impacts of NZ ETS

New Zealand Emissions Trading Scheme	
Independence from Fossil Fuels, and Economic Impact	As of 2011, the additional generation costs were estimated to be: <ul style="list-style-type: none"> • NZ\$13.48 (US\$10.86)/MWh for coal • NZ\$7.98 (US\$6.43)/MWh for gas • NZ\$1.80 (US\$1.45)/MWh for geothermal generation (for fields with significant fugitive emissions).¹⁰⁸
Impacts on Fuel Choice	One effect of the ETS has been to make electricity generated from renewable energy sources a relatively more profitable option for electricity companies than prior to the ETS. Renewable options, such as woody biomass, are now relatively less expensive than before the ETS and the Ministry of Economic Development projects that there will be a steady increase in woody biomass use. ¹⁰⁹
Opportunity for Investments in Infrastructure and Clean Energy/Energy Efficiency	Price incentives from the ETS have encouraged the development of new renewable generation in the country. Eleven new renewable power stations totaling 1,340 MW of capacity were consented in 2010 and 2011. Of those, 59 percent were wind power, 26 percent geothermal, 13 percent hydro, and 2 percent were tidal. ¹¹⁰

¹⁰⁸ Emissions Trading Scheme Review Panel. 2011. Doing New Zealand's Fair Share. Emissions Trading Scheme Review 2011: Final Report. Wellington: Ministry for the Environment. <http://www.climatechange.govt.nz/emissions-trading-scheme/ets-review-2011/>

¹⁰⁹ Ibid.

¹¹⁰ Climate Spectator. August 2011. <http://www.businessspectator.com.au/article/2011/8/1/carbon-markets/smooth-trading-so-far-so-good-nz-ets#ixzz2bUkaBANi>

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Impact on Different Sectors of the Economy	Impact on total business expenditures of NZ\$465 million (US\$374.65), or 0.3 percent, of GDP in 2013 and NZ\$702 million (US\$565.60), or 0.4 percent GDP, in 2015 Expected impact on GDP of -0.1 to -1.0 percent of 2020 level , depending on the scenario modeled. ¹¹¹
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The New Zealand Institute of Economic Research (NZIER) and Infometrics Ltd. were engaged by the Ministry for the Environment to provide economic modeling of the impacts of the NZ ETS in 2020 under a range of scenarios. Scenarios included continuing to exclude the agriculture sector, extending or removing transition measures, and extending or removing free allocation of NZUs. The report found that the impact on New Zealand's GDP could range from -0.1 percent to -1.0 percent of its 2020 level, relative to a scenario where no carbon price is in place and depending on the scenario modeled.¹¹²

The Emissions Trading Scheme Review 2011 suggested several recommendations for the NZ ETS after 2012. Most of the recommendations have been implemented. With these recommendations, the panel estimated that the impact on total business expenditure on energy would be NZ\$465 million (US\$374.65), or 0.3 percent GDP, in 2013 and NZ\$702 million (US\$565.60), or 0.4 percent GDP, in 2015. The panel also estimated impacts specific to the agriculture sector. The impact on the average dairy farmer's expenditure on energy and obligations would be NZ\$4,400 per year in 2013, rising to NZ\$11,200 per year in 2019. The impact to the average sheep and beef farmer would be NZ\$1,600 per year in 2013, rising to NZ\$6,700 per year in 2019. The analysis assumed a NZ\$25 carbon price.¹¹³

5.3 Household Impacts and Co-Benefits

Table 13 summarizes the available household impact and co-benefit information for the NZ ETS.

¹¹¹ New Zealand Institute of Economic Research. Macroeconomic impacts of the New Zealand Emissions Trading Scheme: A Computable General Equilibrium analysis. March 2011.
http://nzier.org.nz/system/files/07.03_BusinessNZ_%20Emissions-2.pdf

¹¹² Ibid.

¹¹³ New Zealand Institute of Economic Research. Macroeconomic impacts of the New Zealand Emissions Trading Scheme: A Computable General Equilibrium analysis. March 2011.
http://nzier.org.nz/system/files/07.03_BusinessNZ_%20Emissions-2.pdf

Table 13: Household Impacts and Co-Benefits of NZ ETS

New Zealand Emissions Trading Scheme	
Effect on Household Consumption and Spending	The Reserve Bank (RBNZ) estimated the effects of the inclusion of the stationary energy sector in the ETS in its June 2010 Monetary Policy Statement. The RBNZ estimated that prices of fuel and electricity would rise by between 3 and 8 percent, increasing consumer price index (CPI) inflation by 0.3 percent. ¹¹⁴ Inclusion of the industrial processing sector in the scheme was not expected to have a noticeable direct impact on consumer prices.
Measures to Mitigate to Low-income Populations, or Economic Impact	<ul style="list-style-type: none"> • NZU price cap of NZ\$25 (US\$20.14)¹¹⁵ • Only one allowance must be surrendered for every two tonnes of CO₂e emitted (non-forestry only)¹¹⁶ • Free allocation of NZUs¹¹⁷ • Introduction of “offsetting” for forestry sector¹¹⁸
Significant Co-benefits	Nitrous oxide emissions in the agriculture sector represent one third of total agricultural emissions. Reduction of these emissions will have an additional environmental co-benefit of improving water quality. ¹¹⁹

Several transitional measures were included in the NZ ETS to limit price exposure to New Zealand industries. The transitional measures were designed to be temporary; however, most have been extended through amendments to the scheme in 2012.¹²⁰ First, compliance entities can continue to purchase NZUs at a fixed price of NZ\$25, which effectively serves as a price ceiling, and free allocations of NZUs are given to businesses with emissions-intensive, trade-exposed activities. Second, the scheme has extended the measure that allows non-forestry participants to surrender one allowance for every two tonnes of CO₂e (the “one-for-two” surrender obligation), which effectively halves the price of allowances. Finally, the forestry sector has been given the flexibility to convert land for other use while avoiding NZ ETS deforestation costs by planting a carbon-equivalent area of forest elsewhere, known as “offsetting”.¹²¹ In addition, entities can continue to use an unlimited number of international

¹¹⁴ Reserve Bank of New Zealand June 2010 Monetary Policy Statement.

http://www.rbnz.govt.nz/monetary_policy/monetary_policy_statement/2010/jun10.pdf

¹¹⁵ New Zealand Ministry of the Environment. November 2012. 2012 Amendments to the New Zealand Emissions Trading Scheme (NZ ETS): Questions and answers. <http://www.climatechange.govt.nz/emissions-trading-scheme/ets-amendments/questions-answers.html>

¹¹⁶ Ibid.

¹¹⁷ New Zealand Ministry of the Environment. Allocation in the New Zealand Emissions Trading Scheme.

<http://www.mfe.govt.nz/publications/climate/allocation-nz-ets-dec07/allocation-nz-ets-dec07.html>

¹¹⁸ New Zealand Ministry of the Environment. Forestry allocation: NZUs for pre-1990 forest. December 2012.

<http://www.climatechange.govt.nz/emissions-trading-scheme/participating/forestry/allocation/>

¹¹⁹ Emissions Trading Scheme Review Panel. 2011. Doing New Zealand’s Fair Share. Emissions Trading Scheme Review 2011: Final Report. Wellington: Ministry for the Environment. <http://www.climatechange.govt.nz/emissions-trading-scheme/ets-review-2011/>

¹²⁰ New Zealand Ministry of the Environment. November 2012. 2012 Amendments to the New Zealand Emissions Trading Scheme (NZ ETS): Questions and answers. <http://www.climatechange.govt.nz/emissions-trading-scheme/ets-amendments/questions-answers.html>

¹²¹ New Zealand Ministry of the Environment. Forestry allocation: NZUs for pre-1990 forest. December 2012. <http://www.climatechange.govt.nz/emissions-trading-scheme/participating/forestry/allocation/>

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emission units, which has been a main driver in reducing the cost of compliance.¹²² The revised legislation does not specify an end date for the extended transition measures; however, they are expected to be in place at least until the next NZ ETS review which is scheduled for 2015.

¹²² ECOFYS. May 2013.

6 Australia Carbon Pricing Mechanism

Policy Definition	Targeted Sector or Emissions
Australia's Carbon Pricing Mechanism (CPM) is the centerpiece of the country's Clean Energy Future plan, which includes a set of national policies aimed at reducing GHG emissions. The pricing mechanism was designed to begin with a fixed carbon price for the first three years, then transition to a flexible price cap-and-trade program.	Covers approximately 60 percent of Australia's emissions including emissions from electricity generation, stationary energy, landfills, wastewater, industrial processes, and fugitive emissions.
GHGs and Costs	
<ul style="list-style-type: none"> The Australian Government estimated that Australia's per capita emissions were around 25 mtCO₂e in 2012, and were projected to increase to 27 mtCO₂e in 2030 without the CPM. With the CPM, per capita emissions are projected to be 21 mtCO₂e in 2030 with domestic abatement only and 13 mtCO₂e with domestic and international abatement included. In July 2013, one year after the start of the CPM, emissions from electricity generation were down over 12 MMtCO₂e, or 6.9 percent. The incoming environment minister Greg Hunt estimates that under the CPM emissions will increase from 560 million metric tons to 637 million metric tons between 2010 and 2020. The Australian Government estimated carbon prices for the fixed price period will be: 2012 to 2013 – AU\$23.00 (US\$21.09) per mtCO₂e 2013 to 2014 – AU\$24.15 (US\$22.15) per mtCO₂e Beginning in July 2014, the flexible-price period will begin and prices will be set by the market. 	
Implementation Issues and Lessons Learned	
<ul style="list-style-type: none"> The future of the CPM faces a challenge under Australia's new Prime Minister, Tony Abbott, who was elected in September 2013. Abbott ran on a campaign against the CPM and his Liberal-National Coalition has stated that its first order of business will be the repeal of the program. The Institute for Energy Research found that it is unlikely that the CPM will achieve least cost abatement. The report also states that political and popular support for the policy has been weak. 	
Costs and Benefits to Consumers	Costs and Benefits to Businesses
<ul style="list-style-type: none"> The Australian Government estimates that during the first year of the CPM household consumption has grown 1.7 percent and that the move to a flexible-price scheme will reduce the growth in overall consumer prices by around 0.5 percent in 2014-2015. The Institute for Energy Research estimates that in the first year of the CPM, household electricity prices have risen 15 percent. Approximately 50 percent of revenue generated from the CPM will be used to compensate households. 	<ul style="list-style-type: none"> The incoming environment minister Greg Hunt says the CPM has lead to manufacturing job losses in the aluminum, steel, paper, cement, auto-manufacturing and chemicals sectors and that policy is eroding business competitiveness. Measures to reduce risk to business under the CPM include fixed priced carbon units for first three years, price ceiling for first three years of flexible-price scheme, and free allocation of carbon units to certain emissions-intensive and trade-exposed activities.

Under Australia's Carbon Pricing Mechanism (CPM), which took effect in July 2012, liable entities must surrender one carbon unit for every metric ton of CO₂e they emit in each subject year. The CPM covers approximately 60 percent of Australia's emissions and includes emissions from electricity generation, stationary energy, landfills, wastewater, industrial

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processes, and fugitive emissions, but does not cover agricultural or transportation emissions.¹²³ Entities in regulated sectors are subject to the CPM if they operate subject facilities with direct (scope 1) emissions that exceed 25,000 mtCO₂e per year.¹²⁴ Households, on-road business use of light-duty vehicles, and the agriculture, forestry and fishery industries do not pay a carbon price for transport fuel under the CPM; however, these sectors will continue to pay a transport fuel excise tax. Emissions from certain business transport fuels, such as rail and shipping, are also subject to an effective carbon price through changes to the tax structure that result in a price equivalent to a carbon price on these emissions.¹²⁵

The CPM was structured to begin effectively as a carbon tax (fixed price) and transition later to a cap and trade system (flexible price). Initial designs called for a gradually increasing fixed price for carbon for each of the first three years of implementation (July 2012 to July 2015), then a transition to a flexible-price scheme in July 2015, when the price of carbon units would be set by the market. However, the Australian Government announced in July 2013 that it has planned to move up the start date of the flexible-price scheme to July 2014, one year earlier than expected. The limit on emissions, known as the “pollution cap”, in the first year of the flexible-price period will be set once the relevant legislation is amended to make 2014-2015 the first flexible-price year. If no regulations are in effect that declare the carbon pollution cap then a default pollution cap will become effective. The default cap is set at 25 MMTCO₂e below the total covered emissions in 2012-2013, and the default cap for all years after 2014-2015 will be 12 MMTCO₂e below the previous year’s cap.¹²⁶

Allowances are purchased from the Australian National Registry of Emissions Units (ANREU), and are also distributed for free through industry assistance programs.¹²⁷ The industry assistance programs include the Jobs and Competitiveness Program (JCP), which helps to limit risk for emissions-intensive and trade-exposed activities, and the Coal-Fired Generation Assistance program, which assists emissions-intensive coal-fired generators to adjust to the CPM. Through the JCP, the most emissions-intensive trade-exposed activities receive free carbon units to cover 94.5 percent of average carbon costs in the first year of the carbon price. Less emissions-intensive trade-exposed activities receive free carbon units to cover 66 percent of average carbon costs in the first year. Assistance reduces by 1.3 percent each year to encourage industry to cut pollution.¹²⁸ The Coal-Fired Generation Assistance program provides free carbon units to eligible generators that pass an annual power system reliability test and submit a Clean Energy

¹²³ Australian Government Clean Energy Regulator: About the carbon pricing mechanism. Accessed July 2013 at: <http://www.cleanenergyregulator.gov.au/Carbon-Pricing-Mechanism/About-the-Mechanism/Pages/default.aspx>

¹²⁴ Ibid.

¹²⁵ Australian Government. Transport Fuels. <http://www.cleanenergyfuture.gov.au/transport-fuels/>

¹²⁶ Australian Government. Starting Emissions Trading on 1 July 2014. Policy Summary. July 2013. <http://www.climatechange.gov.au/sites/climatechange/files/files/reducing-carbon/carbon-pricing-policy/cef-policy-summary-moving-ets.PDF>

¹²⁷ Australian Government Clean Energy Regulator: Industry assistance. Accessed July 2013 at: <http://www.cleanenergyregulator.gov.au/Carbon-Pricing-Mechanism/Industry-Assistance/Pages/default.aspx>

¹²⁸ Australian Government Clean Energy Regulator. <http://www.cleanenergyregulator.gov.au/Carbon-Pricing-Mechanism/Industry-Assistance/jobs-and-competitiveness-program/Pages/default.aspx>

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Investment Plan during each year that assistance is available.¹²⁹ In addition, the CPM allows for the use of domestic, land-based offsets covering up to 100 percent of the compliance obligation beginning in the flexible price period.¹³⁰ After the start of the flexible-price period, allowances will be auctioned by the Clean Energy Regulator, the Government agency responsible for administering the CPM. Free allocation for some entities will continue under the JCP.

The Australian CPM was designed to link to the European Union Emission Trading System (EU ETS) and beginning in 2014, the CPM will permit eligible international carbon units. An interim one-way link, where Australian entities can surrender EU ETS units for compliance, is scheduled to be completed by July 2015, and a full two-way link will be completed by July 2018. This timeframe accommodates the early start to international emissions trading because the link will be in place by July 2015, seven months before the 2014-2015 compliance date of February 1, 2016.¹³¹ International emission units will be limited to 50 percent of an entities liability and the use of other Kyoto offsets, such as emissions reduction projects under the Clean Development Mechanism (CDM) and the Joint Implementation (JI) mechanism, will be phased in and limited to 6.25 percent of an entity's liability in 2014 - 2015, increasing to 12.5 percent in July 2015.¹³²

The future of the CPM faces a challenge under Australia's new Prime Minister, Tony Abbott, who was elected in September 2013. Abbott ran on a campaign against the carbon tax and his Liberal-National Coalition has stated that its first order of business will be the repeal of the CPM. The Government has stated that they will introduce legislation to repeal the CPM on the first sitting day of Parliament.¹³³ The Honourable Greg Hunt, Shadow Minister for Climate Action, Environment and Heritage, has stated that the CPM could then be repealed by July 2014. However, the Liberal-National Coalition does not currently have control of the Senate and therefore will need the Labor party to support the repeal. If the Labor party does not support the repeal, then the ability to pass the legislation will depend on the final makeup of the Senate which will be decided in October or November of 2013.¹³⁴ In place of the CPM, the Government will put forward its Direct Action Plan. The Direct Action Plan is an incentive based policy designed to support emissions reduction activities primarily through a government fund

¹²⁹ Australian Government Clean Energy Regulator. <http://www.cleanenergyregulator.gov.au/Carbon-Pricing-Mechanism/Industry-Assistance/coal-fired-generators/Pages/default.aspx>

¹³⁰ Australian Government Clean Energy Regulator: Eligible emissions units. Accessed July 2013 at <http://www.cleanenergyregulator.gov.au/Carbon-Pricing-Mechanism/About-the-Mechanism/Emissions-units/Pages/default.aspx>

¹³¹ Australian Government. Starting Emissions Trading on 1 July 2014. Policy Summary. July 2013. <http://www.climatechange.gov.au/sites/climatechange/files/files/reducing-carbon/carbon-pricing-policy/cef-policy-summary-moving-ets.PDF>

¹³² Ibid.

¹³³ Australian Broadcasting Company. <http://www.abc.net.au/news/2013-09-18/tony-abbotts-new-ministry-to-be-sworn-in-today/4963842>

¹³⁴ RenewEconomy.com. <http://reneweconomy.com.au/2013/explainer-what-election-result-means-for-carbon-pricing-59122>

(Emissions Reduction Fund) which will use a reverse auction to purchase the lowest cost per ton emission abatement.¹³⁵

6.1 GHG Impacts

If the CPM continues to operate as planned, it will transition to a flexible-price, cap-and-trade style emissions trading scheme in July 2014, one year earlier than expected. During the first year of the program, July 2012 through July 2013, Australia's GHG emissions have decreased, while economic indicators, such as GDP and industrial output, have increased. Since the start of the CPM, emissions from electricity generation, which represent about half of the emissions covered by the CPM, have declined by 7 percent. Table 14 summarizes available GHG related information for the Australian CPM to date.

The Honourable Greg Hunt, Shadow Minister for Climate Action, Environment and Heritage, in a speech to the Grattan Institute Public Seminar in July 2013 stated that the CPM has lead to manufacturing job losses in the aluminum, steel, paper, cement, auto-manufacturing and chemicals sectors. The number of job losses was not provided, and the speech stated that the CPM was not responsible for all of the job losses; however, it cited industry confirmation that the tax has eroding business competitiveness in Australia. The speech also stated that, based on Treasury calculations, emissions will increase from 560 million metric tons to 637 million metric tons between 2010 and 2020.¹³⁶

Table 14: GHG Costs and Benefits of the Australia CPM

Australia CPM

¹³⁵ Honorable Greg Hunt, MP, Shadow Minister for Climate Action, Environment and Heritage. *Choosing the Right Market Mechanisms for Addressing Environmental Problems: Incentives for Action under the Coalition's Direct Action Plan for the Environment and Climate Change*. Speech to the Grattan Institute Public Seminar. July 2013. http://grattan.edu.au/static/files/assets/abf7f66f/521_public_seminar_hunt_speech_outline_130716.pdf

¹³⁶ Ibid.

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Cost of Reductions	<p>The Australian Government estimated carbon prices for the fixed price period will be:</p> <ul style="list-style-type: none"> • 2012 to 2013 – AU\$23.00 (US\$21.09) per mtCO₂e • 2013 to 2014 – AU\$24.15 (US\$22.15) per mtCO₂e <p>Beginning in July 2014, the flexible-price period will begin and prices will be set by the market, which may bring the price in line with the EU ETS price, which is currently expected to be around AU\$6 (US\$5.49) per mtCO₂e.¹³⁷</p> <p>A study conducted by the Institute for Energy Research in September 2013 which estimated the economic impacts of the CPM found the following:¹³⁸</p> <ul style="list-style-type: none"> • The study found that between 2013 and 2020 there is an average GDP loss of AU\$48 (US\$44.94) for each metric ton of abatement (more than half of which is sourced from overseas), with costs as high as AU\$142 (US\$132.94) per metric ton in 2013. • As part of the household compensation package included with the CPM the Australian Government lowered average income tax rates for some (about 560,000) but actually increased marginal tax rates for many more, resulting in an effective tax increase for 2.2 million taxpayers. • The main economic effect of the CPM so far has been to increase energy prices (particularly electricity costs) for households and businesses.
Volume of Reductions	<ul style="list-style-type: none"> • Total annual emissions as of September 2012 were estimated to be 551.9 MMTCO₂e, a decrease of 0.2 percent from September 2011 emissions of 553.2 MMTCO₂e.¹³⁹ • The Australian Government estimated that Australia's per capita emissions were around 25 mtCO₂e in 2012, and were projected to increase to 27 mtCO₂e in 2030 without the CPM. With the CPM, per capita emissions are projected to be 21 mtCO₂e in 2030 with domestic abatement only, and 13 mtCO₂e with domestic and international abatement included.¹⁴⁰ • In July 2013, one year after the start of the CPM, emissions from electricity generation were down over 12 MMTCO₂e, or 6.9 percent.¹⁴¹

¹³⁷ Australian Government. Starting Emissions Trading on 1 July 2014. Policy Summary. July 2013. <http://www.climatechange.gov.au/sites/climatechange/files/files/reducing-carbon/carbon-pricing-policy/cef-policy-summary-moving-ets.PDF>

¹³⁸ Robson, A. PhD. Australia's Carbon Tax: An Economic Evaluation. Institute for Energy Research. September 2013. <http://americanenergyalliance.us2.list-manage.com/track/click?u=7cbc7dd79831a84c870f9842e&id=85bd12ab9b&e=8c028b49d1>

¹³⁹ Australian Government. Quarterly Update of Australia's National Greenhouse Gas Inventory: December 2012. <http://www.climatechange.gov.au/climate-change/greenhouse-gas-measurement-and-reporting/tracking-australias-greenhouse-gas-emissio-0/quarterly-update-australias-national-greenhouse-gas-inventory-march-13>

¹⁴⁰ Australian Government. How Australia's Carbon Price is Working One Year On. July 2013. <http://www.cleanenergyfuture.gov.au/wp-content/uploads/2013/08/carbon-price-one-year-on.pdf>

¹⁴¹ Ibid.

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Programmatic Status	<p>The CPM only began in July 2012, and the start of the flexible-price period will not begin until July 2014. However, the first year of the CPM has been a success according to a report by the Government of Australia. In a report prepared in July 2013, the Government reports that emissions from the electricity sector had decreased by 7 percent, renewable energy generation had increased by 25 percent, generation from coal had decreased 12.5 percent, and over 160,000 new jobs had been created. The report also stated that from the period July 2011- May 2012 to July 2012- May 2013, GDP had grown 2.5 percent, industrial production had grown 5.1 percent, retail trade had grown 3.1 percent, and household consumption had grown 1.7 percent. The report did not specify how much, if any, of this growth is attributable to the CPM.¹⁴²</p> <p>The Institute for Energy Research study conducted in September 2013 found that it is unlikely that the CPM will achieve least cost abatement. The report also states that political and popular support for the policy has been weak and that there is a great deal of uncertainty surrounding the future status of the tax, especially in light of the recent national election.¹⁴³</p>
Emissions Leakage	<p>The Institute for Energy Research study found that Australian businesses have seen energy cost increases as a result of the CPM and that many of these businesses have not been unable to pass on these costs increases. The report suggests that the most likely reason for the lack of pass-through of cost increases is that the businesses are either producing goods for export or are competing directly against goods imported from overseas and therefore face a fixed world price for their output. In these cases the CPM is likely to lead to carbon leakage rather than a reduction in global emissions.¹⁴⁴</p>

6.2 Energy and Economic Impacts

The CPM has had an impact on fuel choice in Australia. Since the start of the CPM, the Australian Government has estimated that electricity generation from renewables has increased 25 percent and generation from coal has decreased 13 percent. The Australian Government estimates that impacts on Australia's economy have been minimal since the start of the program. The Government estimates that over 160,000 new jobs have been created since the start of the CPM and that GDP has grown 2.5 percent, though no causation has been established.¹⁴⁵ The CPM includes several measures to limit the economic impacts and reduce risk to business.

A study by the Institute for Energy Research released in September 2013 assessed the economic impacts of the CPM and found that it is unlikely that the program will achieve least cost

¹⁴² Ibid.

¹⁴³ Robson, A. PhD. Australia's Carbon Tax: An Economic Evaluation. Institute for Energy Research. September 2013. <http://americanenergyalliance.us2.list-manage.com/track/click?u=7cbc7dd79831a84c870f9842e&id=85bd12ab9b&e=8c028b49d1>

¹⁴⁴ Ibid.

¹⁴⁵ Ibid.

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abatement. The report also states that political and popular support for the policy has been weak and that there is a great deal of uncertainty surrounding the future status of the tax, especially in light of the recent national election.¹⁴⁶

Table 15 summarizes available energy and economic impacts of the Australian CPM.

Table 15: Energy and Economic Impacts of the Australia CPM

Australia CPM	
Independence from Fossil Fuels, and Economic Impact	The CPM, along with the country's Renewable Energy Target (20 percent renewable by 2020), have coincided with an increase in generation from clean energy sources. One year after implementation renewable energy generation has increased by 25 percent and natural gas generation has increased by 4.4 percent. Generation from coal has decreased by 13 percent. By 2020, renewable energy generation is expected to increase by 60 to 80 percent. ¹⁴⁷
Impacts on Fuel Choice	The CPM has helped to increase electricity generation from renewable sources and natural gas and decrease generation from coal. See above.
Opportunity for Investments in Infrastructure and Clean Energy/Energy Efficiency	In addition to the increase in renewable energy and natural gas generation noted above, CPM revenue is funding the Government's Clean Technology Program which provides over AU\$1(US\$0.91) billion to help businesses invest in new energy efficiency and pollution reduction equipment. ¹⁴⁸ The Low Income Energy Efficiency Program is providing up to AU\$63 (US\$57.28) million for energy efficiency measures for around 33,000 low income households. ¹⁴⁹

¹⁴⁶ Robson, A. PhD. Australia's Carbon Tax: An Economic Evaluation. Institute for Energy Research. September 2013. <http://americanenergyalliance.us2.list-manage.com/track/click?u=7cbc7dd79831a84c870f9842e&id=85bd12ab9b&e=8c028b49d1>

¹⁴⁷ Australian Government. How Australia's Carbon Price is Working One Year On. July 2013. <http://www.cleanenergyfuture.gov.au/wp-content/uploads/2013/08/carbon-price-one-year-on.pdf>

¹⁴⁸ Ibid.

¹⁴⁹ Ibid.

Impact on Different Sectors of the Economy	<p>Jobs:</p> <ul style="list-style-type: none"> • Since the start of the CPM, over 160,000 new jobs were created across the economy, including clean energy jobs. The source did not specify how many of the jobs created were directly attributable to the CPM¹⁵⁰ • The Honorable Greg Hunt, MP, Shadow Minister for Climate Action, Environment and Heritage, stated in a speech in July 2013 that since the CPM was introduced Australia has seen manufacturing job losses in the aluminum, steel, paper, cement, auto-manufacturing and chemicals sectors.¹⁵¹ <p>Electricity:</p> <ul style="list-style-type: none"> • Electricity spot prices increased sharply after the start of the CPM in July 2012, then decreased through the start of October 2012. The average spot price in June 2012, just before the start of the CPM, was around AU\$37 (US\$33.64)/MWh. The average spot price in the three months after the CPM was just over AU\$58 (US\$52.73)/MWh.¹⁵² The average spot price for the first two months of the 2013 – 2014 financial year was around AU\$56 (US\$51.16)/MWh.¹⁵³ <p>Measures to reduce risk to business under the CPM include:</p> <ul style="list-style-type: none"> • Fixed priced carbon units for first three years (2013 – 2015): This measure stabilizes the financial impact to entities and avoids price spikes during the implementation of the CPM. • Price ceiling for first three years of flexible-price scheme (2016 – 2018): Similar to the fixed price measure, the price ceiling prevents price spikes during the transition to a flexible-price trading scheme. • Free allocation of carbon units to certain emissions-intensive and trade-exposed activities: This measure helps emission intensive entities transition to a carbon price and reduces incentives for these entities to relocate to countries with climate policies different than those in Australia.
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6.3 Household Impacts and Co-Benefits

The Australian Government expects positive impacts on households from the early move to a flexible-price emission trading scheme. The Government has estimated that annual household costs will be around AU\$380 (US\$347.17) lower, on average, in the 2014 – 2015 financial

¹⁵⁰ Ibid.

¹⁵¹ The number of job losses was not provided. Source: Honorable Greg Hunt, MP, Shadow Minister for Climate Action, Environment and Heritage. *Choosing the Right Market Mechanisms for Addressing Environmental Problems: Incentives for Action under the Coalition's Direct Action Plan for the Environment and Climate Change*. Speech to the Grattan Institute Public Seminar. July 2013.

http://grattan.edu.au/static/files/assets/abf7f66f/521_public_seminar_hunt_speech_outline_130716.pdf

¹⁵² Australian Energy Market Operator. Carbon Price – Market Review. November 2012.

http://www.aemo.com.au/Electricity/Resources/Reports-and-Documents/~/_media/Files/Other/reports/CarbonPrice_MarketReview.ashx

¹⁵³ Australian Energy Market Operator. Average Price Tables. <http://www.aemo.com.au/Electricity/Data/Price-and-Demand/Average-Price-Tables>

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year.¹⁵⁴ The CPM also includes a range of programs to help households adjust to the financial impacts of a carbon price and includes compensation measures focused on low-to-middle income households. Table 16 summarizes the available household impact and co-benefit information for the Australian CPM.

Table 16: Household Impacts and Co-Benefits of the Australia CPM

Australia CPM	
Effect on Household Consumption and Spending	<p>The Australian Government estimates that an early move to a flexible-price emissions trading scheme will lower household cost of living.¹⁵⁵</p> <ul style="list-style-type: none"> • Reduce the growth in overall consumer prices by around 0.5 percent in 2014-2015 • On average, household costs are estimated to be around AU\$7.30 (US\$6.68) per week lower, or AU\$380 (US\$347.93) lower per year in 2014-15 as a result of moving to an early flexible-price scheme. <p>During the first year of the CPM, household consumption has grown 1.7 percent.¹⁵⁶</p> <p>The Institute for Energy Research, in a report released in September 2013, estimates that:¹⁵⁷</p> <ul style="list-style-type: none"> • In the first year of the CPM, household electricity prices have risen 15 percent, including the biggest quarterly increase on record. • Currently 19 percent of a typical household electricity bill in Queensland and 16 percent in New South Wales is due to the CPM and other “green” programs such as the renewable energy mandate.
Measures to Mitigate to Low-income Populations, or Economic Impact	<p>The CPM includes compensation measures focused on low-to-middle income households. Approximately 50 percent of revenue generated from the CPM will be used to compensate households, including:¹⁵⁸</p> <ul style="list-style-type: none"> • Increase in the tax-free threshold rising from AU\$18,200 (US\$16,689) in 2012-13 rising to AU\$19,400 (US\$17,789) in 2015-16 • Increases in family benefit payments, pensions and allowances to assist households to meet cost increases • Households are exempt from the carbon price on transport fuel use, however, households continue to pay a transport fuel excise tax. <p>The Low Income Energy Efficiency Program is providing up to AU\$63 (US\$57.28) million for energy efficiency measures for around 33,000 low income households.¹⁵⁹</p>

¹⁵⁴ Australian Government. How Australia’s Carbon Price is Working One Year On. July 2013.

<http://www.cleanenergyfuture.gov.au/wp-content/uploads/2013/08/carbon-price-one-year-on.pdf>

¹⁵⁵ Australian Government. Households’ cost of living under an early emissions trading scheme (ETS). Fact Sheet. 2013. <http://www.climatechange.gov.au/sites/climatechange/files/files/reducing-carbon/carbon-pricing-policy/households-cost-ets.pdf>

¹⁵⁶ Australian Government. How Australia’s Carbon Price is Working One Year On. July 2013.

<http://www.cleanenergyfuture.gov.au/wp-content/uploads/2013/08/carbon-price-one-year-on.pdf>

¹⁵⁷ Robson, A. PhD. Australia’s Carbon Tax: An Economic Evaluation. Institute for Energy Research. September 2013. <http://americanenergyalliance.us2.list-manage.com/track/click?u=7cbc7dd79831a84c870f9842e&id=85bd12ab9b&e=8c028b49d1>

¹⁵⁸ Deloitte. Australia’s carbon pricing mechanism: Key issues for business. 2011. https://www.deloitte.com/assets/Dcom-Australia/Local%20Assets/Documents/Services/Climate%20change%20and%20sustainability/Deloitte_carbon_pricing_mechanism%20.pdf

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Significant Co-benefits	Certain projects under the Carbon Farming Initiative (CFI), a program related to the CPM which allows farmers and land managers to earn carbon credits by storing carbon or reducing emissions on their land, includes provisions to promote projects that produce co-benefits to biodiversity or Indigenous communities. ¹⁶⁰
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¹⁵⁹ Australian Government. How Australia's Carbon Price is Working One Year On. July 2013.

<http://www.cleanenergyfuture.gov.au/wp-content/uploads/2013/08/carbon-price-one-year-on.pdf>

¹⁶⁰ Australian Government. Carbon Farming Initiative. Avoiding negative outcomes and supporting co-benefits.

<http://www.climatechange.gov.au/reducing-carbon/carbon-farming-initiative/cfi-handbook-0/avoiding-negative-outcomes-and-supporting>

7 British Columbia Carbon Tax

Policy Definition		Targeted Sector or Emissions
A carbon tax imposed on fuels based on their carbon intensity. All taxes collected are recycled in a revenue neutral manner through reduction in income taxes.		Energy
GHGs and Costs		
<ul style="list-style-type: none"> Set in 2008 to CAD\$10 per mtCO₂e, escalating CAD\$5 per year to CAD\$30 in 2012. From 2008 to 2011, BC's per capita GHG emissions associated with carbon-taxed fuels declined by 10 percent. In absence of all other GHG reduction strategies, the carbon tax alone is estimated to cause a reduction in BC's emissions in 2020 by up to 3 MMTCO₂e annually. 		
Implementation Issues and Lessons Learned		
<ul style="list-style-type: none"> The BC carbon tax is still too low in terms of price to drive a shift to new low-carbon practices and technologies. Carbon tax revenues can be used in a variety of ways; BC has used tax revenue to offset personal and corporate income taxes. WA could offset other taxes. Corporate tax cuts are now absorbing a substantial share of carbon tax revenues As the price per mtCO₂e rises, the carbon tax will become increasingly regressive to low-income households for whom energy costs are a larger portion of overall income. 		
Costs and Benefits to Consumers		Costs and Benefits to Businesses
<ul style="list-style-type: none"> Increase in gasoline and other energy costs proportional to their energy content. Reduction in personal income tax rates, which can compensate for increased energy prices associated with the carbon tax. Between 2008 and 2011, the BC GDP has slightly outperformed the rest of the Canadian economy.¹⁶¹ 		<ul style="list-style-type: none"> Increase in gasoline and other energy costs proportional to their energy content. Industries with high emissions intensities, such as cement production, petroleum refining, oil and gas extraction and some other manufacturing subsectors have been impacted. Reduction in corporate tax rates. Increasing the carbon tax beyond the current CAD\$30/mtCO₂e would have a stronger negative impact on economic growth.

On July 1, 2008, British Columbia (BC) implemented the BC Carbon Tax Act, the first carbon tax policy in North America. The BC carbon tax imposes a price on the use of carbon-based fuels, including gasoline, diesel, jet fuel, natural gas, propane, and coal. BC's carbon tax was designed to be "revenue neutral," as all revenue generated by the tax is used to reduce other taxes – mainly through cuts to income taxes (personal and corporate), as well as targeted tax relief for vulnerable households and communities, resulting in no overall increase in taxation. Although Washington does not have an income tax, there are other taxes that could be reduced if significant carbon tax revenue were generated. The tax covers three quarters (77 percent) of the province's GHG emissions from residential, commercial, and industrial sources. The measure is

¹⁶¹ Elgie and McClay. BC's Carbon Tax Shift After Five Years: Results, An Environmental (and Economic) Success Story. (July 2013). Accessed August 2013 at: <http://www.sustainableprosperity.ca/article3685>

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a central component of BC's climate change strategy that aims to reduce GHG emissions by 33 percent below 2007 levels by 2020.¹⁶²

A 2013 review of the program by Sustainable Prosperity concluded that "BC's carbon tax shift has been a highly effective policy to date. It has contributed to a significant reduction in fossil fuel use per capita, with no evidence of overall adverse economic impacts, and has enabled BC to have Canada's lowest income tax rates." However, the authors go on to note that "further economic analysis is needed to reach more firm conclusions about these effects and causality," and that it is "too early to draw solid conclusions on the tax shift's economic effects."¹⁶³

When introduced in 2008, the BC carbon tax was set at CAD\$10 (US\$9.68) per mtCO₂e. It was designed to rise by CAD\$5 (US\$4.84) per year thereafter until it reached CAD\$30 (US\$29.04) per mtCO₂e in 2012. Since different fuels generate different amounts of GHGs when burned, the CAD\$30 (US\$29.04) per mtCO₂e is translated into tax rates for specific fuel types. For example, the current rate for a liter of gasoline is CAD\$0.0667 (US\$0.227/gallon) and the current rate for a liter of diesel is CAD\$0.0767 (US\$0.265/gallon).¹⁶⁴

According to the BC Ministry of Finance, the revenue-neutral carbon tax is based on the following principles¹⁶⁵:

- **All carbon tax revenue is recycled through tax reductions.** The government has a legal requirement to present an annual plan to the legislature demonstrating how all the carbon tax revenue will be returned to taxpayers through tax reductions. The money will not be used to fund government programs.
- **Allow time to adjust.** The tax rate started low and increased gradually to allow individuals and businesses time to adjust.
- **Protect low-income individuals and families.** Low-income individuals and families are protected through a refundable Low Income Climate Action Tax Credit designed to offset the carbon tax.
- **The tax has the broadest possible base.** Virtually all emissions from fuel combustion in BC captured by Environment Canada's National Inventory Report are taxed, with no exceptions except those required for integration with other climate action policies in the future and for efficient administration.
- **The tax will be integrated with other measures.** The carbon tax will not, on its own, meet BC's emission-reduction targets, but it is a key element in the strategy. The carbon tax and

¹⁶² Elgie and McClay. BC's Carbon Tax Shift After Five Years: Results, An Environmental (and Economic) Success Story. (July 2013). Accessed August 2013 at: <http://www.sustainableprosperity.ca/article3685>

¹⁶³ Elgie and McClay. BC's Carbon Tax Shift After Five Years: Results, An Environmental (and Economic) Success Story. (July 2013). Accessed August 2013 at: <http://www.sustainableprosperity.ca/article3685>

¹⁶⁴ British Columbia Ministry of Finance: What is the Carbon Tax?. Accessed August 2013 at: <http://www.fin.gov.bc.ca/tbs/tp/climate/A1.htm>

¹⁶⁵ British Columbia Ministry of Finance. Tax Cuts Funded by the Carbon Tax. Accessed August 2013 at: <http://www.fin.gov.bc.ca/tbs/tp/climate/A2.htm>

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complementary measures such as “cap and trade” system will be integrated as other measures are designed and implemented.

The tax puts a price on carbon to encourage individuals, businesses, industry, and others to use less fossil fuel and reduce their GHG emissions. In addition, it sends a consistent price signal, ensuring that those who produce emissions pay for them, and makes clean energy alternatives more competitive.¹⁶⁶ According to Sustainable Prosperity, the majority of energy and carbon intensive industries in Canada are overwhelmingly in favor of a price on carbon, but there is no consensus on the pricing mechanism.¹⁶⁷

Most economists also consider that a carbon tax has several advantages over the alternative pricing instrument, a cap and trade system. These include easier comprehensive coverage of emission sources, administrative simplicity and frugality (it uses existing public and private tax administrative infrastructures), speed of establishment, low transaction costs, price certainty (critical for investment decisions), and transparency for consumers (critical for influencing behavior).¹⁶⁸ Nonetheless, a Congressional Budget Office analysis found that a carbon tax would have a negative effect on the economy prior to accounting for the use of carbon tax revenue. The report also concluded that “some uses of those revenues could substantially offset the total economic costs resulting from the tax itself, whereas other uses would not.”¹⁶⁹

British Columbia is Washington’s neighbor to the north, and the carbon tax has five years of implementation history available for review. Additionally, because the transportation sector is such a large portion of Washington’s GHG emissions, the application of the carbon tax to transportation fuels in British Columbia may provide insight into consumer response. The revenue neutral nature of British Columbia’s carbon tax may also highlight ways to mitigate potential economic impacts.

7.1 GHG Impacts

A review of the BC Carbon Tax Act was completed in July 2013 by researchers at the University of Ottawa. The researchers found that GHG emissions declined by a combined 10 percent from 2008 to 2011 when compared with GHG emissions in 2007, the year before the tax was implemented. GHG emissions in the rest of Canada over the same period saw a reduction of only 1.1 percent. The researchers noted that the experience in BC is consistent with the results

¹⁶⁶ British Columbia Ministry of Finance: Carbon Tax Review, and Carbon Tax Overview. Accessed August 2013 at: http://www.fin.gov.bc.ca/tbs/tp/climate/carbon_tax.htm

¹⁶⁷ Sustainable Prosperity. Canadian Business Preference on Carbon Pricing. January 2011. Accessed August 2013 at: <http://www.sustainableprosperity.ca/dl329&display>

¹⁶⁸ Sustainable Prosperity. *British Columbia Carbon Tax Review*. September 2012. Accessed August 2013 at: <http://www.sustainableprosperity.ca/dl891&display>

¹⁶⁹ Congressional Budget Office. 2013. Effects of a Carbon Tax on the Economy and the Environment. Accessed September 2013 at: <http://www.cbo.gov/publication/44223>

witnessed in seven European countries that enacted carbon tax shifts in the 1990s.¹⁷⁰ Table 17 summarizes additional GHG related information for the BC Carbon Tax Act.

Table 17: GHG Costs and Benefits of the BC Carbon Tax Act

BC Carbon Tax Act	
Cost of Reductions	<p>The BC Carbon Tax Act was implemented in 2008 with a tax initially set at CAD\$10 (US\$9.68) per mtCO₂e. The BC Carbon Tax included a rise of CAD\$5 (US\$4.84) per year until it reached CAD\$30 (US\$29.04) per mtCO₂e in 2012. The current carbon tax rates are¹⁷¹:</p> <ul style="list-style-type: none"> • Gasoline – CAD\$0.0667/liter (US\$0.227/gallon) • Diesel – CAD\$0.00767/liter (US\$0.265/gallon) • Coal – high heat value - \$CAD62.31/tonne (US\$60.34/metric ton) • Coal – low heat value - \$CAD53.31/tonne (US\$51.63/metric ton) • Natural Gas – CAD\$0.057/m³ (US\$0.0016/ft³) <p>2010/11 Carbon Tax Revenue was CAD\$741 (US\$717) million.¹⁷²</p> <p>A recent review of the policy determined the tax will remain at CAD\$30 (US\$29.04) per mtCO₂e for the foreseeable future.¹⁷³</p>
Volume of Reductions	<p>From 2008 to 2011, BC's per capita GHG emissions associated with carbon-taxed fuels declined by 10 percent. During this period, BC's reductions outpaced those in the rest of Canada by 8.9 percent.¹⁷⁴ Quantitative volumes were not noted.</p> <p>In absence of all other GHG reduction strategies, the carbon tax alone is estimated to cause reduction in BC's emissions in 2020 by up to 3 MMTCO₂e annually.¹⁷⁵</p>
Programmatic Status	<p>Since the implementation of the carbon tax in 2008, BC has seen a drop in fuel consumption and GHG emissions, though some of this may be attributable to the global economic downturn. Additionally, BC households and businesses now pay the lowest income taxes in Canada.¹⁷⁶</p> <p>After a review of the tax in 2012, BC confirmed it would keep its revenue-neutral carbon tax.¹⁷⁷</p>

¹⁷⁰ Elgie and McClay. BC's Carbon Tax Shift After Five Years: Results, An Environmental (and Economic) Success Story. (July 2013). Accessed August 2013 at: <http://www.sustainableprosperity.ca/article3685>

¹⁷¹ British Columbia Ministry of Finance: How the Carbon Tax Works. Accessed August 2013 at: <http://www.fin.gov.bc.ca/tbs/tp/climate/A4.htm>

¹⁷² British Columbia Ministry of Finance. June Budget Update – 2013/14 to 2014/15, Carbon Tax Review. 2013. Accessed August 2013 at: http://www.fin.gov.bc.ca/tbs/tp/climate/Carbon_Tax_Review_Topic_Box.pdf

¹⁷³ Ibid.

¹⁷⁴ Elgie and McClay. BC's Carbon Tax Shift After Five Years: Results, An Environmental (and Economic) Success Story. (July 2013). Accessed August 2013 at: <http://www.sustainableprosperity.ca/article3685>

¹⁷⁵ British Columbia Ministry of Finance: How the Carbon Tax Works. Accessed August 2013 at: <http://www.fin.gov.bc.ca/tbs/tp/climate/A4.htm>

¹⁷⁶ Elgie and McClay. BC's Carbon Tax Shift After Five Years: Results, An Environmental (and Economic) Success Story. (July 2013). Accessed August 2013 at: <http://www.sustainableprosperity.ca/article3685>

¹⁷⁷ British Columbia Ministry of Finance: Carbon Tax Review, and Carbon Tax Overview. Accessed August 2013 at: http://www.fin.gov.bc.ca/tbs/tp/climate/carbon_tax.htm

Emissions Leakage	No GHG leakage was noted in the literature, though there have been reports of BC residents purchasing lower cost gasoline in Washington. ¹⁷⁸
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7.2 Energy and Economic Impacts

Economic analysis conducted for the carbon tax review indicates that BC's carbon tax has had, and will continue to have, a small negative impact on GDP in the province. The economic impact varies by industry and some industries are more impacted than others. Following the review, the BC government decided to maintain the current tax rate of CAD\$30 (US\$29.04) per mtCO₂e, and the carbon tax base will not be expanded or broadened to include industrial processes or other non-combustion emissions.¹⁷⁹ Increasing the carbon tax rates or expanding the base to include industrial process emissions would increase costs for BC business and decrease competitiveness.¹⁸⁰

A report released in July 2013 found that per capita consumption of petroleum fuels subject to the BC carbon tax decreased by 17.4 percent from the 2007 base year to 2012. Conversely, per capita consumption of petroleum fuels subject to the BC carbon tax increased by 1.5 percent in the rest of Canada over the same time period. Based on the pre-tax trend from 2000-2008 – when BC per capita fuel consumption decreased 0.1 percent per year *less* than the rest of Canada – the author concludes that “while BC was doing about as well as the rest of Canada in reduction of fuel use before 2008, it has done much better since the carbon tax came in – suggesting that the tax was an important contributor to BC's success in reducing fuel use in the past four years.”¹⁸¹ This analysis is presented in Figure 5.

¹⁷⁸ CTV British Columbia. May 2013. Tax gap has B.C.ers driving south for gas: watchdog. Accessed September 2013 at: <http://bc.ctvnews.ca/tax-gap-has-b-c-ers-driving-south-for-gas-watchdog-1.1285011>

¹⁷⁹ British Columbia Ministry of Finance. June Budget Update – 2013/14 to 2014/15, Carbon Tax Review. 2013. Accessed August 2013 at: http://www.fin.gov.bc.ca/tbs/tp/climate/Carbon_Tax_Review_Topic_Box.pdf

¹⁸⁰ Ibid.

¹⁸¹ Elgie and McClay. BC's Carbon Tax Shift After Five Years: Results, An Environmental (and Economic) Success Story. (July 2013). Accessed August 2013 at: <http://www.sustainableprosperity.ca/article3685>

Figure 5: Sales of Petroleum Fuels Subject to BC Carbon Tax, 2000-2012. (Graphic Excerpted from Elgie and McClay 2013)¹⁸²

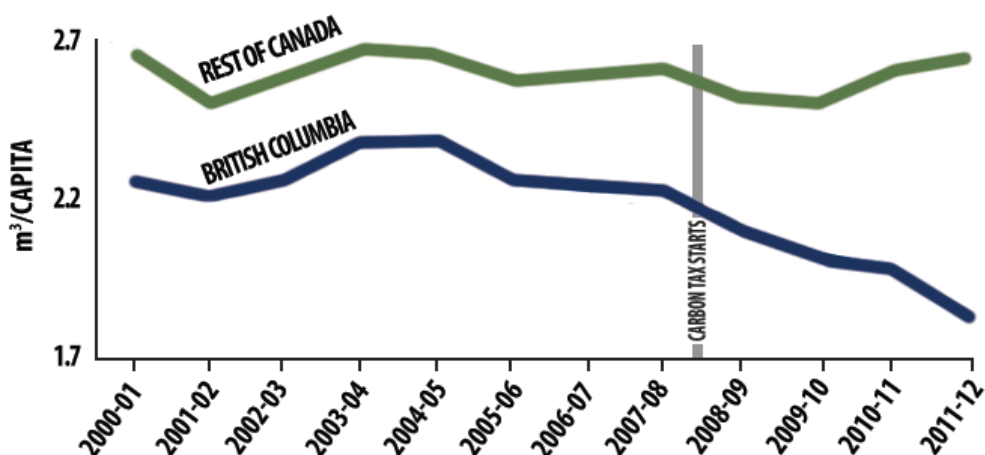


Table 18 summarizes additional available energy and economic impacts of the BC Carbon Tax Act.

Table 18: Energy and Economic Impacts of the BC Carbon Tax Act

BC Carbon Tax Act	
Independence from Fossil Fuels, and Economic Impact	<p>Reduction of fossil fuel use by 17.4 percent per capita from 2008 to 2012¹⁸³ increases energy independence.</p> <ul style="list-style-type: none"> • 2010/11 Carbon Tax Revenue CAD\$741 (US\$717) million • 2010/11 Personal Tax Reductions CAD\$391 (US\$378) million • 2010/11 Business Tax Reductions CAD\$474 (459) million¹⁸⁴ <p>For the 2012/13 fiscal year, the tax reductions are expected to return CAD\$260 (US\$252) million more to taxpayers than the amount of carbon tax paid.¹⁸⁵</p>
Impacts on Fuel Choice	<p>Between 2008 and 2012, fossil fuel use in BC has dropped 17.4 percent per capita when compared to the fuel use in 2007. Over the same time period, fossil fuel use in the rest of Canada increased by 1.5 percent.¹⁸⁶ This is represented in Figure 5.</p>

¹⁸² Ibid.

¹⁸³ Ibid.

¹⁸⁴ British Columbia Ministry of Finance. *June Budget Update – 2013/14 to 2014/15, Carbon Tax Review*. 2013. Accessed August 2013 at: http://www.bcbudget.gov.bc.ca/2012/bfp/2012_Budget_Fiscal_Plan.pdf

¹⁸⁵ British Columbia Ministry of Finance. *Tax Cuts Funded by Carbon Tax*. Accessed August 2013 at: <http://www.fin.gov.bc.ca/tbs/tp/climate/A2.htm>

¹⁸⁶ Elgie and McClay. *BC's Carbon Tax Shift After Five Years: Results, An Environmental (and Economic) Success Story*. (July 2013). Accessed August 2013 at: <http://www.sustainableprosperity.ca/article3685>

Opportunity for Investments in Infrastructure and Clean Energy/Energy Efficiency	Analysts determined the carbon tax is still too low in terms of price to drive a shift to new low-carbon practices and technologies . Public investment to accelerate low-carbon practices and support demonstration and pilot projects in alternative emerging technologies is also needed. ¹⁸⁷
Impact on Different Sectors of the Economy	Between 2008 and 2011, the BC GDP has slightly outperformed the rest of the Canadian economy . ¹⁸⁸ However, industries with high emissions intensities, such as cement production, petroleum refining, oil and gas extraction and some other manufacturing subsectors have been impacted . Increasing the carbon tax beyond the current CAD\$30/mtCO ₂ e would have a stronger negative impact on economic growth. ¹⁸⁹

7.3 Household Impacts and Co-Benefits

The BC carbon tax affects home heating and vehicle fuelling for BC families. In July 2012, The BC Ministry of Environment estimated that the cost of the carbon tax to fill the gas tank would cost an additional CAD\$2.80 (US\$2.71) for a compact car, CAD\$3.80 (US\$3.68) for a mid-sized sedan, and CAD\$5.10 (US\$4.94) for an SUV. Similar household costs occur for families that use a natural gas or oil furnace to heat their home. Tax reductions included in the revenue neutral policy offset these increased costs on households. The Government also provides programs for families to reduce their emissions and save costs including home retrofit programs and clean energy vehicle incentive programs.¹⁹⁰

The Low Income Climate Action Tax credit helps offset the impact of the carbon taxes paid by low-income individuals.¹⁹¹ Another measure to mitigate the carbon tax for families includes the Northern and Rural Homeowner Benefit that helps homeowners outside of metropolitan areas reduce the amount of taxes they pay on their homes.¹⁹²

Modeling of the program found that as the price per mtCO₂e rises, the carbon tax will become increasingly regressive to low-income households. The low-income credit would shrink from one-third of revenues in 2008/09 to 19 percent in 2010/11 and 12 percent in 2012/13. A similar drop is expected to happen to the personal income tax cut. Corporate tax cuts are now absorbing

¹⁸⁷ Sustainable Prosperity. *British Columbia Carbon Tax Review*. September 2012. Accessed August 2013 at: <http://www.sustainableprosperity.ca/dl891&display>

¹⁸⁸ Elgie and McClay. BC's Carbon Tax Shift After Five Years: Results, An Environmental (and Economic) Success Story. (July 2013). Accessed August 2013 at: <http://www.sustainableprosperity.ca/article3685>

¹⁸⁹ British Columbia Ministry of Finance. *June Budget Update – 2013/14 to 2014/15, Carbon Tax Review*. 2013. Accessed August 2013 at: http://www.fin.gov.bc.ca/tbs/tp/climate/Carbon_Tax_Review_Topic_Box.pdf

¹⁹⁰ British Columbia Ministry of Environment. *Making Progress on B.C.'s Climate Action Plan*. 2012. Accessed August 2013 at: <http://www.env.gov.bc.ca/cas/pdfs/2012-Progress-to-Targets.pdf>

¹⁹¹ British Columbia. *Low Income Climate Action Tax Credit*. Accessed August 2013 at: <http://www2.gov.bc.ca/gov/topic.page?id=E9258ADE1AE3423080A1B2674F4EAABD>

¹⁹² British Columbia Ministry of Finance. *Tax Cuts Funded by the Carbon Tax*. Accessed August 2013 at: <http://www.fin.gov.bc.ca/tbs/tp/climate/A2.htm>

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a substantial share of carbon tax revenues.¹⁹³ Table 19 summarizes the projected impact on households by income group and year.¹⁹⁴

Table 19. Estimated BC Carbon Tax and Revenue Recycling by Income Group, 2008/09 to 2010/11 (Graphic Excerpted from Lee 2008)

Table 2: BC Carbon Tax and Revenue Recycling by Income Group, 2008/09 to 2010/11						
	All households	Lowest quintile	Second quintile	Third quintile	Fourth quintile	Highest quintile
Average dollars per household (unless otherwise stated)						
2008/09						
Carbon taxes paid (direct and indirect) (\$)	253	107	166	247	316	427
Low-income credit (\$)	86	129	147	139	13	1
Personal income tax cuts (\$)	69	1	18	54	102	167
Corporate income tax cuts (\$)	99	15	42	57	60	322
Total recycled benefits (\$)	253	145	207	250	175	489
Net gain (loss) (\$)		38	40	3	(141)	62
Share of income		0.2%	0.1%	0.0%	(0.2%)	0.0%
2009/10						
Carbon taxes paid (\$)	380	161	250	370	473	641
Low-income credit (\$)	90	136	155	146	14	1
Personal income tax cuts (\$)	162	3	42	127	242	395
Corporate income tax cuts (\$)	128	19	54	74	77	416
Total recycled benefits (\$)	380	158	251	347	333	812
Net gain (loss) (\$)		(3)	1	(24)	(141)	171
Share of income		0.0%	0.0%	0.0%	(0.2%)	0.1%
2010/11						
Carbon taxes paid (\$)	507	215	333	494	631	854
Low-income credit (\$)	90	136	155	146	14	1
Personal income tax cuts (\$)	231	5	60	181	344	562
Corporate income tax cuts (\$)	185	28	78	107	112	603
Total recycled benefits (\$)	507	168	293	434	469	1165
Net gain (loss) (\$)		(47)	(40)	(60)	(162)	311
Share of income		(0.3%)	(0.1%)	(0.1%)	(0.2%)	0.2%
Notes: Estimates are for the full July 1 to June 30 year in accordance with the carbon tax. See Technical Appendix for details on how recycled revenues are allocated across quintiles.						
Source: Authors' calculations based on Statistics Canada's Survey of Household Expenditure and Social Planning Simulation Database and Model, and BC Budget 2008.						

¹⁹³ Lee. Fair and Effective Carbon Pricing, Lessons from BC. February 2011. Accessed August 2013 at: <http://www.policyalternatives.ca/publications/reports/fair-and-effective-carbon-pricing>

¹⁹⁴ Lee. Is BC's Carbon Tax Fair?, An impact Analysis for Different Income Levels. October 2008. Accessed August 2013 at: http://www.policyalternatives.ca/sites/default/files/uploads/publications/BC_Office_Pubs/bc_2008/ccpa_bc_carbontaxfairness.pdf

Table 20 summarizes the available household impact and co-benefit information for the BC Carbon Tax Act. Table 19 summarizes the estimated BC carbon tax and revenue recycling by income group.

Table 20: Household Impacts and Co-Benefits of the BC Carbon Tax Act

BC Carbon Tax Act	
Effect on Household Consumption and Spending	<p>The BC government “recycles” all revenues from the carbon tax back to households and businesses in the form of tax cuts and low-income tax credits. In 2008/09, the carbon tax was estimated to be moderately progressive, where households saw a net gain from the policy. By 2010/11, the regime is moderately regressive, where only the highest quintile saw a net gain. Table 19 presents the estimated carbon tax costs and tax reductions for households of varying income levels.¹⁹⁵</p> <p>BC carbon tax policy analysis suggests income tax reductions and credits should be indexed to any future increases in the carbon tax rate.¹⁹⁶</p>
Measures to Mitigate to Low-income Populations, or Economic Impact	<p>The following personal income tax measures are funded by the BC Carbon Tax Act¹⁹⁷:</p> <ul style="list-style-type: none"> • BC Low Income Climate Action Tax Credit: CAD\$184 (US\$178) million in reductions in 2011/12; CAD\$195 (US\$189) million in 2012/13 • Reduction of 5 percent in the first two personal income tax rates: CAD\$220 (US\$213) million in 2011/12; CAD\$235 (US\$227) million in 2012/13 • Northern and Rural Homeowner Benefit of \$200: CAD\$66 (US\$64) million in 2011/12; CAD\$67 (US\$65) million in 2012/13
Significant Co-benefits	<p>As a result of the carbon tax shift, BC is tied with Alberta and New Brunswick for the lowest corporate tax rate in Canada, increasing competitiveness. It also has the lowest personal income tax rate in Canada, for those earning up to CD\$119,000 (US\$115,020)¹⁹⁸</p>

¹⁹⁵ Ibid.

¹⁹⁶ Sustainable Prosperity. British Columbia Carbon Tax Review. September 2012. Accessed August 2013 at: <http://www.sustainableprosperity.ca/dl891&display>

¹⁹⁷ British Columbia Ministry of Finance. June Budget Update – 2013/14 to 2014/15, Carbon Tax Review. 2013. Accessed August 2013 at: http://www.fin.gov.bc.ca/tbs/tp/climate/Carbon_Tax_Review_Topic_Box.pdf

¹⁹⁸ Elgie and McClay. BC’s Carbon Tax Shift After Five Years: Results, An Environmental (and Economic) Success Story. (July 2013). Accessed August 2013 at: <http://www.sustainableprosperity.ca/article3685>

8 Low Carbon Fuel Standard Detailed Overview

Policy Definition	Targeted Sector or Emissions
And LCFS mandates a reduction in the carbon intensity of the transportation fuel mix, on average, over time, considering the entire lifecycle of the fuel. The potential action for consideration in this case is the implementation of a Low Carbon Fuel Standard constituting a 10 percent reduction in the carbon intensity of the fuel mix over a 10 year time period in the State of Washington.	Transportation
GHGs and Costs	
<ul style="list-style-type: none"> California: Total costs, including production, storage, transport and dispensing for various alternative fuels range from \$1.4/GGE (cellulosic ethanol) to \$7.2/GGE (hydrogen).¹⁹⁹ California ARB estimates GHG reductions in 2020 of 15,800,000 from direct combustion of transportation fuels (in 2020) and 22,900,000 from the full fuel lifecycle (in 2020).²⁰⁰ Oregon: While costs were not estimated for the Oregon LCFS program, the volume of reductions from the program is expected to range from 2,189,000 to 2,285,000 (in 2022).²⁰¹ 	
Implementation Issues and Lessons Learned	
<ul style="list-style-type: none"> There may be legal challenges to implementing an LCFS at state as opposed to federal level, as evidenced by the current litigation surrounding California's LCFS. Sector exemptions should be carefully considered, such as those included in the California LCFS program. The California LCFS does not cover military activity, the racing industry, the aviation industry, marine fuels, or locomotive fuels.²⁰² Of important consideration to Washington will be the marine fuel exemption, which will affect the Washington State Ferries. 	
Costs and Benefits to Consumers	Costs and Benefits to Businesses
<ul style="list-style-type: none"> Fuel prices may fluctuate, based on fuel prices, development of refining capacity for in-state biofuel production or purchase out-of-state alternative fuels, among other factors EVs and AFVs are more expensive upfront than traditionally fueled base vehicles. These costs can be largely made up through Federal and state tax 	<ul style="list-style-type: none"> Shifts away from petroleum-based fuels (gasoline and diesel) will have negative impacts on businesses involved in oil production, refining and transportation Significant increases in biofuel production will positively impact the farming and agricultural sectors of the economy, with

¹⁹⁹ Baral, A. International Council on Clean Transportation. *Summary Report on Low Carbon Fuel-Related Standards*. (October 2009). Page 11. Accessed July 2013 at: http://www.theicct.org/sites/default/files/publications/ICCT_LCFS_workingpaper_Oct09.pdf (page 11)

²⁰⁰ California Air Resources Board (CARB). *Proposed Regulation to Implement the Low Carbon Fuel Standard: Volume I: Staff Report: Initial Statement of Reasons*. (March 2009). Page VII-5. Accessed July 2013 at: http://www.arb.ca.gov/fuels/lcfs/030409lcfs_isor_vol1.pdf

²⁰¹ Oregon Department of Environmental Quality. *HB 2186: Oregon Low Carbon Fuel Standards and Truck Efficiency*. (March 2013). Page 234. Accessed July 2013 at: <http://www.deq.state.or.us/pubs/legislativepubs/2013/HB2186LegRpt2013.pdf>

²⁰² California Air Resources Board (CARB). Final Regulation Order. Subchapter 10. Climate Change. Article 4. Regulations to Achieve Greenhouse Gas Emission Reductions. Subarticle 7. Low Carbon Fuel Standard. Section 95480.1(d) Exemption for Specific Applications (Page 3). <http://www.arb.ca.gov/fuels/lcfs/CleanFinalRegOrder112612.pdf>

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credits and over the term of ownership through lower fuel prices.²⁰³

additional demand for fuel feedstock

- Shifts toward natural gas or electricity produced in-state will have positive impacts on businesses involved in those industries

A low carbon fuel standard (LCFS) requires a reduction in the carbon intensity of the transportation fuel mix, on average, over time, considering the entire lifecycle of the fuel. The lifecycle of petroleum-based fuels includes the GHG emissions associated with crude recovery, crude transportation, fuel production, fuel transportation, and end use of the fuel in motor vehicles. The regulated entities tend to be fuel producers and importers who sell motor gasoline and diesel fuel. The most common method for generating the credits required for compliance is the use of ethanol, followed by, to a lesser extent, natural gas and bio-based gases, biodiesel, and electricity.²⁰⁴

California and British Columbia have implemented LCFS, Oregon has an existing LCFS that is scheduled to “sunset” in 2015, and Washington has considered implementing an LCFS in the past, including in response to an executive order from then-Governor Christine Gregoire in 2009 to investigate the potential for use of LCFS. If Washington joins California and British Columbia in implementing an LCFS, and if Oregon’s LCFS is renewed, the western U.S. and Canada will have developed a “clean fuels” region of harmonized policies and market signals that could serve as an example for broader implementation, potentially at a national level. In 2007, the Washington State Climate Advisory Team’s Transportation Sector Technical Work Group estimated that a Low Carbon Fuel Standard that includes a 10 percent carbon intensity reduction by 2020 would result in 15.2 million metric tons CO₂e cumulative emission reductions from 2008 to 2020 at a cost of \$119/mtCO₂e.²⁰⁵

At a national level, Congress has adopted a renewable fuels standard (RFS) under the Energy Independence and Security Act (EISA), which requires fuel providers to gradually increase the amount of biofuel in their products through 2022 (both cellulosic and biomass-based, though there are separate targets for each). The goals of an RFS and an LCFS are interrelated, but different, as are their structures. An RFS is explicitly targeted at increasing the supply of renewable fuels, and is generally prescriptive about the fuels that can be used for compliance. An LCFS on the other hand, provides a market mechanism that may be met through the use of renewable fuels, but is not prescriptive about which fuels must be used or to what extent. GHG

²⁰³ Mello, T. B. Ownership costs of traditional versus alternative fuel vehicles: Department of Energy calculator breaks down pricing. Autoweek. February 4, 2013. Accessed September 2013 at: <http://www.autoweek.com/article/20130204/carnews/130209970>

²⁰⁴ UC Davis Institute of Transportation Studies, *Status Review of California’s Low Carbon Fuel Standard*, S.Yeh, J. Witcover, J. Kessler, Spring 2013, p. 1

²⁰⁵ Washington State Climate Advisory Team Transportation Policy Option Descriptions. *Transportation Sector Technical Work Group Policy Option Recommendations*. (December 2007). Accessed July 2013 at: http://www.ecy.wa.gov/climatechange/interimreport/122107_TWG_trans.pdf

reductions associated with improved fossil fuel production pathways are as equally legitimate in the context of an LCFS as GHG reductions associated with the use of renewable or alternative fuels. Currently, there is no national LCFS, and studies have returned conflicting results on the potential impacts of implementing such a policy. A national study was conducted by the National LCFS Project in 2010, which included technical analysis and policy design recommendations for establishing an LCFS in the United States.²⁰⁶ The findings of the study indicated that implementing a national LCFS would reduce petroleum consumption and lower fuel prices for consumers, reduce crop prices for fuel production due to a shift toward cellulosic crops, and reduce national and global GHG emissions.²⁰⁷ Conversely, in 2010, Charles River Associates found that implementing a national LCFS would cause damaging price shocks in the immediate term due to the limited availability of alternative fuels to meet suggested standards. The resulting economic shock would cause a loss of jobs, reduce household purchasing power, reduce investment, and impact regional and national GDP, according to the analysis.²⁰⁸ Further discussion of a LCFS policy is included in the Task 3 report on Federal policies.

8.1 Existing Policies

This section summarizes low carbon fuel standards implemented in other jurisdictions. The following programs are included:

The California Air Resources Board Low Carbon Fuel Standard Program: Established under California Assembly Bill (AB) 32 and Governor Schwarzenegger's 2007 Executive Order S-01-07, the California LCFS is a performance-based measure that aims to cut the carbon intensity of transportation fuels by at least 10 percent by 2020.²⁰⁹ Under the standard, which ARB began implementing in 2010, carbon intensity is measured in grams of CO₂ equivalent per mega-Joule (gCO₂e/MJ), and fuel providers must demonstrate that their fuel mix meets the LCFS standards for each annual compliance period through a system of "credits" and "deficits" whereby the carbon intensity of a particular fuel in the portfolio is either lower than or higher than the standard for gasoline or diesel, respectively.²¹⁰ These intermediate targets are set from a baseline carbon intensity for the fuel mix supplied to the state, with a declining average carbon

²⁰⁶ National Low Carbon Fuel Standard Project. Accessed July 2013 at: <http://nationallcfsproject.ucdavis.edu/>

²⁰⁷ National Low Carbon Fuel Standard Project. National Low Carbon Fuel Standard Technical Analysis Report. (July 19, 2012). Page 6. Accessed July 2013 at: <http://nationallcfsproject.ucdavis.edu/files/pdf/2012-07-nlcs-technical-analysis-report.pdf>

²⁰⁸ Montgomery, D., et. al. *Economic and Energy Impacts Resulting from a National Low Carbon Fuel Standard*. Charles River Associates. (June 2010). Pages 2-3. Accessed July 2013 at: http://www.dec.ny.gov/docs/administration_pdf/cra.pdf

²⁰⁹ California Assembly Bill 32, Chapter 488. Accessed July 2013 at: <http://www.arb.ca.gov/fuels/lcfs/ab32.pdf>, and California Office of the Governor, Executive Order EO S-01-07. Accessed July 2013 at: <http://www.arb.ca.gov/fuels/lcfs/eos0107.pdf>

²¹⁰ California Air Resources Board. *Low Carbon Fuel Standard 2011 Program Review Report*. (December 8, 2011). Page 23. Accessed July 2013 at: http://www.arb.ca.gov/fuels/lcfs/workgroups/advisorypanel/20111208_LCFS%20program%20review%20report_final.pdf

intensity over time. The performance-based nature in the California LCFS allows for flexibility, as regulated entities can incorporate new or improved technologies into existing production pathways, or develop new production pathways to reduce the carbon intensity of their fuel mix. In addition, credits may be banked and traded on the LCFS market to realize compliance. The California LCFS accounts for emissions associated with both direct and indirect land use change in its development of lifecycle carbon intensities.

There have been several court challenges to the California LCFS regarding the potential impact of the regulation on agricultural and ethanol production practices in other states, challenging that the regulation unfairly impacts out-of-state producers and therefore regulates conduct outside of California. On December 29, 2011, the U.S. District Court for the Eastern Division of California found that the regulation violated the Interstate Commerce Clause of the U.S. Constitution, and further that ARB had failed to establish that there are no alternate means of reaching GHG goals.²¹¹ On April 23, 2012, the U.S. Court of Appeals for the Ninth Circuit granted a stay of injunction while ARB appeals the injunction, which allows ARB to enforce the LCFS program until the appeal is resolved.²¹² On June 6, 2013 California's Fifth Court of Appeals issued a provisional ruling in the case of *POET, LLC vs. California Air Resources Board, et al.*, which charged that the LCFS was implemented without adequate study of environmental impacts.²¹³ In the latest action as of the drafting of this document, the court has allowed ARB to proceed with the existing regulation but has provided formal direction for addressing the concerns raised by the lawsuit.²¹⁴

Oregon Low Carbon Fuel Standard Program: The Oregon LCFS was authorized in 2009 under House Bill 2186, and includes a mandate to cut carbon intensity in cars and trucks by 10 percent per gallon by 2025. During the program design process, safeguards such as exemptions, deferrals, and periodic program reviews, to protect producers, consumers and regulated parties from unintended negative consequences, such as increased prices were included as important topics to address.²¹⁵

²¹¹ Green Car Congress. *Federal Judge Rules California Low Carbon Fuel Standard Violates Commerce Clause of US Constitution*. (December 30, 2011). Accessed July 2013 at: <http://www.greencarcongress.com/2011/12/lcfs-20111230.html>

²¹² Stoel Rives, LLP. *Energy Law Alert: California Permitted to Enforce Low Carbon Fuel Standard Pending Appeal*. (April 30, 2012). Accessed July 2013 at: <http://www.stoel.com/showalert.aspx?Show=9482>

²¹³ The Court of Appeal of the State of California for the Fifth Appellate District. *POET, LLC et al. v. California Air Resources Board et al.* (June 3, 2013). Accessed July 2013 at: <http://www.edf.org/sites/default/files/5th%20appellate%20LCFS%20ruling%206.3.13.pdf>

²¹⁴ Voegelé, E. *Court Rules California's LCFS Will Remain in Effect*. Biomass Magazine. (June 6, 2013). Accessed July 2013 at: <http://biomassmagazine.com/articles/9068/court-rules-californias-lcfs-will-remain-in-effect/>

²¹⁵ Oregon Department of Environmental Quality. *Oregon Low Carbon Fuel Standards Advisory Committee Process and Program Design*. (January 25, 2011). Pages 101-104. Accessed July 2013 at: <http://www.deq.state.or.us/aq/committees/docs/lcfs/reportFinal.pdf>

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HB 1286 contains a sunset provision that would effectively end the LCFS in 2015 unless the legislature votes to override the provision. As of a state Senate vote on July 8, 2013, the LCFS will be allowed to expire in 2015, but the topic may be heard for reconsideration at a short session of the Senate in February 2014.²¹⁶ The Oregon Department of Environmental Quality never moved to implement the standards because of the sunset date.

British Columbia Renewable and Low Carbon Fuel Requirements Regulation: British Columbia's LCFS, which was established under the province's Greenhouse Gas Reduction Act (SBC 2008, Chapter 16), applies to all fuels used for transportation in British Columbia, and includes a target of a 10 percent reduction in carbon intensity in those fuels by 2020.²¹⁷ Transportation fuel suppliers calculate a weighted average carbon intensity for their fuel mix, and there is currently no credit/deficit trading system for trading allowances, though the regulation allows for 'notional transfers' of emissions among suppliers.²¹⁸ British Columbia's LCFS includes only emissions from direct land use change in its development of lifecycle carbon intensities.

Because of regulatory structure, there is a concern that the policy may reduce the use of crudes (such as Canadian oil sands) within the LCFS jurisdiction, but these crudes may still be used elsewhere to produce fuel (with added emissions from additional transportation).²¹⁹

European Union Fuel Quality Directive: The European Union's Fuel Quality Directive was established in 2009 under Directive 2009/30/EC, and requires the GHG intensity of transportation fuels, specifically petroleum, diesel and biodiesel, to be reduced by up to 10 percent by 2020. The policy includes a binding 6 percent reduction in the GHG intensity of these fuels by 2020 for fuel suppliers, with intermediate targets of 2 percent by 2014 and 4 percent by 2017; the remaining 4 percent of the 10 percent target is non-binding, and contingent upon the development of new technologies such as carbon capture and storage (additional 2 percent reduction on the 10 percent target), and the purchase of credits through the Clean Development Mechanism (CDM) (additional 2 percent reduction on the 10 percent target).²²⁰ The EU is

²¹⁶ Zheng, Y. The Oregonian. *Oregon Senate rejects 'clean fuels' bill, a top priority for environmental lobby*. (July 6, 2013). Accessed July 2013 at:

http://www.oregonlive.com/politics/index.ssf/2013/07/oregon_senate_rejects_clean_fu.html#incart_river; and Greenwire. E&E Publishing. *State Senate rejects clean fuels bill*. (July 8, 2013). Accessed July 2013 at: <http://www.eenews.net/greenwire/2013/07/08/stories/1059983987>

²¹⁷ British Columbia Ministry of Energy and Mines. *Renewable & Low Carbon Fuel Requirements Regulation*. Accessed July 2013 at: <http://www.empr.gov.bc.ca/RET/RLCFRR/Pages/default.aspx>

²¹⁸ Natural Resources Defense Council. *A Comparison of California and British Columbia's Low Carbon Fuel Standards*. (March 2010). Page 4. Accessed July 2013 at: http://climateactionnetwork.ca/archive/webyp-system/program/download.php?FILENAME=53-31-at-PDF_File_Upload_1.pdf&ORG_FILENAME=BC_and_CA_fuel_standard_comparison_FINAL.pdf

²¹⁹ Natural Resources Defense Council. March 2010.

²²⁰ European Commission. *Fuel Quality*. Accessed July 2013 at: http://ec.europa.eu/clima/policies/transport/fuel/index_en.htm

currently reviewing the potential to include indirect land use change from biofuels in its Directive.

Of these four programs the following sections present results for the California LCFS and the Oregon LCFS. As WCI partners, and with programs that have sufficient centralized program structure and detailed documentation, these programs were deemed most appropriate for use by Washington.

8.2 GHG Impacts

The volume of GHG emissions reductions ranges depending on the quantity of fuel consumed in the state and on the target set for the LCFS; one-year (2020) estimates from California indicate up to a 22.9 MMTCO₂e reduction from the full fuel life cycle, while one-year (2022) estimates from Oregon indicate up to 2.3 MMTCO₂e reduction. Both programs are in relatively early stages of implementation and have faced significant challenges to program implementation and endurance. Table 21 summarizes the available GHG-related information for the California and Oregon programs.

Table 21: GHG Costs and Benefits of Example LCFS Programs

California	
Cost of Reductions	<p>Total costs, including production, storage, transport and dispensing for various alternative fuels range from \$1.4/GGE (cellulosic ethanol) to \$7.2/GGE (hydrogen)²²¹</p> <p>The California Electric Transportation Coalition is currently undertaking a comprehensive economic study to understand the Program's macroeconomic impacts.²²²</p>
Volume of Reductions	<p>15,800,000 mtCO₂e from direct combustion of transportation fuels (in 2020)</p> <p>22,900,000 mtCO₂e from the full fuel lifecycle (in 2020)²²³</p>

²²¹ Baral, A. International Council on Clean Transportation. *Summary Report on Low Carbon Fuel-Related Standards*. (October 2009). Page 11. Accessed July 2013 at: http://www.theicct.org/sites/default/files/publications/ICCT_LCFS_workingpaper_Oct09.pdf (page 11)

²²² California Electric Transportation Coalition. *California's Low Carbon Fuel Standard: Compliance Outlook for 2020*. (Phase I report). (June 2013). Accessed July 2013 at: <http://www.caletc.com/wp-content/downloads/LCFSReportJune.pdf> (Phase II will include macroeconomic modeling which will include (1) changes in gross state/regional product, (2) changes in employment and income, (3) changes in total economic production, and (4) inter-industry and aggregate impacts.

²²³ California Air Resources Board (CARB). *Proposed Regulation to Implement the Low Carbon Fuel Standard: Volume I: Staff Report: Initial Statement of Reasons*. (March 2009). Page VII-5. Accessed July 2013 at: http://www.arb.ca.gov/fuels/lcfs/030409lcfs_isor_vol1.pdf

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Programmatic Status	The program is in the early stages of implementation, and faces ongoing litigation. Costs and benefits of the program will be better understood over time. However, reports have found that the LCFS is on target and is encouraging technological innovation through private investment. ²²⁴
Emissions Leakage	None noted.
Oregon	
Cost of Reductions	None noted.
Volume of Reductions	2,189,000 to 2,285,000 mtCO₂e (in 2022) ²²⁵
Programmatic Status	The program has been designed but not implemented as of 2013 because of the pending “sunset” date in 2015
Emissions Leakage	None noted.

8.3 Energy and Economic Impacts

Table 22 summarizes the available energy and economic impact information for the California and Oregon LCFS programs. Ex post data to evaluate the impact of the LCFS in California is not yet available. However, in analyzing the costs and benefits of its LCFS policy, California ARB assumed that future fossil fuel costs would be unchanged, and that net benefits of up to \$0.08 per gallon may accrue. However, a study by Boston Consulting Group estimated that implementation of California LCFS would result in increased costs to industry requiring cost recovery of \$0.33 to \$1.06 per gallon.²²⁶ A subsequent analysis by the UC Davis Policy Institute, however, concluded that the BCG report was too narrow in scope (looked solely at the refining sector), and included a variety of problematic assumptions.²²⁷ Additionally, BCG’s cost estimates reflect a compliance pathway where fossil fuel providers are forced to purchase LCFS credits from producers of low carbon fuels. As such, these costs represent a wealth transfer within the economy, and not a net cost to the State.

²²⁴ California Electric Transportation Coalition. Rapid Developments in Alternative Fuels Surpassing Expectations. (Press Release June 13, 2013). Accessed July 2013 at: <http://www.caletc.com/wp-content/downloads/LCFSReportJunePressRelease.pdf>

²²⁵ Oregon Department of Environmental Quality. *HB 2186: Oregon Low Carbon Fuel Standards and Truck Efficiency*. (March 2013). Page 234. Accessed July 2013 at: <http://www.deq.state.or.us/pubs/legislativepubs/2013/HB2186LegRpt2013.pdf>

²²⁶ Boston Consulting Group. 2012. Understanding the impact of AB 32. Accessed September 2013 at: http://cafuelfacts.com/wp-content/uploads/2012/07/BCG_report.pdf

²²⁷ UC Davis Policy Institute for Energy, Environment and the Economy. 2013. Expert Evaluation of the Report: “Understanding the Impacts of AB32”. Accessed September 2013 at: http://policyinstitute.ucdavis.edu/files/general/pdf/2013-05-09_Expert-Evaluation-of-BCG-Report.pdf
May 2013

Table 22: Energy and Economic Impacts of Example LCFS Programs

California	
Independence from Fossil Fuels, and Economic Impact	<p>Fossil fuel use will be reduced through increased use and production of biofuels.</p> <p>This reduced use would produce an overall savings in the state of \$11 billion over the 10-year period (\$0 - \$0.08 per gallon)²²⁸</p> <p>No estimated fiscal impact for the first three years, but potential loss of annual state tax revenue of \$80-\$370 million in 2020 from lost transportation-fuel taxes, including excise and sales taxes, depending on the compliance paths chosen²²⁹</p>
Impacts on Fuel Choice	ARB Staff determined that the LCFS will not significantly impact transportation fuel price or supply. ²³⁰
Opportunity for Investments in Infrastructure and Clean Energy/Energy Efficiency	The state estimated that 24 biorefineries will be constructed as a result of the policy, including both cellulosic ethanol and biodiesel/renewable diesel facilities. ²³¹
Impact on Different Sectors of the Economy	<p>Expected to generate investment in low-carbon ethanol, biodiesel, renewable diesel, biogas, and natural gas facilities along with investment in alternative vehicle technologies.</p> <p>Costs to oil industry associated with LCFS credit purchase. These may translate to benefits to low carbon fuel providers.</p> <p>Industries involved in the movement of goods, including the trucking industry, have cited potential increases in fuel costs as concern for revenue and employment.²³²</p>
Oregon	
Independence from Fossil Fuels, and Economic Impact	Macroeconomic modeling analysis, sponsored by the Oregon DEQ and conducted during the Advisory Committee process, concluded that an OR LCFS would have significant positive economic effects, unless all low carbon fuel production occurred out of state.
Impacts on Fuel Choice	An LCFS incentivizes the use of lower-carbon fuels, such as biofuels, CNG, LNG, and alternative energy to achieve mandates. The macroeconomic model scenario projection generating the largest positive impact anticipated significant investment in new infrastructure for electricity and compressed natural gas. ²³³

²²⁸ ARB March 2009. Page ES-26. Accessed July 2013 at:
http://www.arb.ca.gov/fuels/lcfs/030409lcfs_isor_vol1.pdf

²²⁹ Ibid.

²³⁰ Ibid.

²³¹ Ibid.

²³² California Trucking Association. *The Impact of the Low Carbon Fuel Standard and Cap and Trade Programs on California Retail Diesel Prices*. (April 2012). Accessed July 2013 at:
<http://caltrux.org/sites/default/files/CTALCFS.pdf>

²³³ State of Oregon Department of Environmental Quality, Oregon Low Carbon Fuel Standards Advisory Committee Process and Program Design, Final Report, January 25, 2011, Accessed July 2013 at
<http://www.deq.state.or.us/aq/committees/docs/lcfs/reportFinal.pdf>

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Opportunity for Investments in Infrastructure and Clean Energy/Energy Efficiency	<p>Creates 800-29,000 jobs over 10 years, increasing income in Oregon between \$60 and \$2,630 million over 10 years.²³⁴</p> <p>Overall, the six scenarios modeled in the analysis sponsored by the Oregon DEQ involving in-state production of biofuels (A through C and E through G) have fairly similar GSP impacts, ranging from approximately \$900 million to about \$1.25 billion in additional economic activity.²³⁵</p>
Impact on Different Sectors of the Economy	<p>Macro-economic modeling sponsored by the Oregon DEQ showed that each of the following saw at least \$50 million in additional volume (output and value added) in at least one modeling scenario:²³⁶</p> <ul style="list-style-type: none">• Construction• Real Estate• Wholesale Trade• Professional Services• Healthcare• Banking• Waste Management• Administrative Services <p>Further, the DEQ-sponsored macroeconomic assessment found that “no one of these nine specific sectors modeled in this analysis saw significant negative impacts as a result. Also, no sector was projected to experience negative impacts of a size on the scale of the positive impacts identified in these nine.”²³⁷</p>

8.4 Household Impacts and Co-Benefits

Under an LCFS, fossil fuel use will be reduced through increased use and production of biofuels, and production of biofuels may stimulate the local economy. Drawbacks may occur with impacts of crop use on agricultural resources and increased water consumption associated with crop production for biofuel use. Table 23 summarizes the available household impact and co-benefit information for the California and Oregon LCFS programs.

²³⁴ Jack Faucett Associates, Inc. Economic Impact Analysis of the Low-Carbon Fuel Standard Rule for the State of Oregon, Prepared for the Oregon Department of Environmental Quality, 11-AQ-004d, January 2011. Accessed August 2013 at <http://www.deq.state.or.us/aq/committees/docs/lcfs/appendixDeconimpact.pdf>

²³⁵ Jack Faucett Associates, Inc. Page 30. January 2011

²³⁶ Jack Faucett Associates, Inc. Page 32-33. January 2011.

²³⁷ Jack Faucett Associates, Inc. Page 32. January 2011.

Table 23: Household Impacts and Co-Benefits of Example LCFS Programs

California	
Effect on Household Consumption and Spending	As crop-based biofuel production increases, there will be a competing pressure on fuel prices, which may cause upward pressure on food prices ²³⁸ In its initial statement of reasons, ARB estimated that the policy would result in a net savings over the life of the policy, which would amount to a (\$0 - \$0.08 per gallon) savings if passed entirely to the consumer. ARB acknowledged that the savings are highly dependent on the future price of fossil fuels, availability of lower-carbon intensity fuels, and the economic recovery. ²³⁹
Measures to Mitigate to Low-income Populations, or Economic Impact	Program includes safeguards such as exemptions, deferrals, and periodic program reviews, to protect producers, consumers and regulated parties from unintended negative consequences, such as increased prices. ²⁴⁰
Significant Co-benefits	Reduced particulate matter emissions from diesel. ²⁴¹ Drawbacks to the program may include: ²⁴² <ul style="list-style-type: none"> • Increased water consumption associated with Biofuel production • Impacts on agricultural resources Impacts on biological resources with new construction
Oregon	
Effect on Household Consumption and Spending	None noted.
Measures to Mitigate to Low-income Populations, or Economic Impact	None noted.
Significant Co-benefits	Domestic and in-state production of replacement fuels stimulates economy ²⁴³

²³⁸ CARB March 2009. Page ES-29. Accessed July 2013 at:
http://www.arb.ca.gov/fuels/lcfs/030409lcfs_isor_vol1.pdf

²³⁹ ARB March 2009. Page ES-26. Accessed July 2013 at:
http://www.arb.ca.gov/fuels/lcfs/030409lcfs_isor_vol1.pdf

²⁴⁰ Oregon Department of Environmental Quality. Oregon Low Carbon Fuel Standards: Advisory Committee Process and Program Design. (January 25, 2011). Pages 101-104. Accessed July 2013 at:
<http://www.deq.state.or.us/aq/committees/docs/lcfs/reportFinal.pdf>

²⁴¹ CARB March 2009. Page ES-24. Accessed July 2013 at:
http://www.arb.ca.gov/fuels/lcfs/030409lcfs_isor_vol1.pdf

²⁴² CARB March 2009. Page VII 25-28. Accessed July 2013 at:
http://www.arb.ca.gov/fuels/lcfs/030409lcfs_isor_vol1.pdf

²⁴³ Oregon DEQ (January 2011). Page 16.

9 Road Usage Pricing Policies (Cordon and Toll)

Policy Definition	Targeted Sector or Emissions
<p>Road usage charge policies impose direct charges for the use of a roadway or roadways, with various goals for pricing approaches. Goals may include revenue generation or incentivizing behavioral changes such as use of alternative routes or modes of transportation shift, avoiding travel at congested times of the day, or foregoing travel altogether. These policies are often implemented with the primary objective of generating revenue or reducing congestion during off -peak hours, but have the co-benefit of some net reduced vehicle miles traveled (VMT), which limits fuel used for passenger motor vehicle travel and GHG emissions from transportation. Pricing mechanisms may include tolls, cordon pricing, congestion charge zones, or charges on certain vehicle classes.</p>	Transportation
GHGs and Costs	
<ul style="list-style-type: none"> Pricing strategies to reduce VMT are often implemented as revenue generation and congestion relief policies, with GHG reduction as an ancillary benefit. All of the program data for the Road Usage Pricing Programs of focus in other jurisdictions (tolls and cordon areas) indicated that they were generally successful and generated revenue, though there has been some evidence of traffic leakage onto surrounding, un-priced roads. 	
Implementation Issues and Lessons Learned	
<ul style="list-style-type: none"> Depending on pricing implementation, potential to disproportionately impact low income users; mitigation for impacts should be considered When considering road pricing options, the potential to limit mobility for non-discretionary users (freight and trucking industry, businesses using the highway system to provide goods and services), should be mitigated 	
Costs and Benefits to Consumers	Costs and Benefits to Businesses
<ul style="list-style-type: none"> Congestion relief Decrease in travel times Decrease in traffic accidents due to reduced number of vehicle trips Toll prices are direct costs to Washington travelers Consumer cost savings are case-specific, and will depend on the amount of travel, among other factors Depending on pricing implementation, potential to disproportionately impact low income users; mitigation for impacts should be considered Revenue raised increases the State's ability to maintain, operate and expand the transportation system 	<ul style="list-style-type: none"> Potential adverse impact on sales for some city-center retailers (for cordon policies), though the net impact is expected to be negligible²⁴⁴ Revenue raised increases the State's ability to maintain, operate and expand the transportation system

²⁴⁴ Danna, et. al. *A Benefit-Cost Analysis of Road Pricing in Downtown Seattle*. Evans School Review. Vol. 2, Num. 1, Spring 2012. Page 37. Accessed September 2013 at: <https://depts.washington.edu/esreview/wordpress/wp-content/uploads/2012/12/ESR-2012-A-Benefit-Cost-Analysis-of-Road-Pricing-in-Downtown-Seattle.pdf>

9.1 Existing Policies

This section analyzes existing policies implemented in other jurisdictions related to road usage pricing policies. The following programs are included:

London Congestion Pricing: Since 2003, the city of London has charged a congestion fee based on location and time of day, the first of its kind in a European city.²⁴⁵ The fee applies in central London on weekdays, with private motorists required to pay a flat rate between the hours of 7:00 am and 6:30 pm for entering the charge area. Motorcycles, licensed taxis, disabled persons, some AFVs, buses, and emergency vehicles are given exemptions, and area residents receive a 90 percent discount on the fee. Payments are made at retail establishments, payment machines, the internet, and by telephone messaging, and vehicle users can purchase weekly, monthly, or annual passes at discounts up to 15 percent.²⁴⁶

A 2011 study by the Victoria Policy Institute notes several areas in which the system could be improved: fees could be adjusted based on the number of miles driven within the charging area, fees could be time-variable (highest during the most congested hours), fees could vary by congestion (highest on the most congested roads), overhead costs are high for the London system, and alternate forms of public transportation (namely, the subway system the Tube) could be further supplemented by additional bus service.²⁴⁷

Stockholm: From January through August 2006, the city of Stockholm implemented a cordon zone pilot project to test its potential as a road congestion reduction policy proposal.²⁴⁸ The trial included variable pricing based on the time of day, with fees ranging from 10 SEK to 20 SEK (about US\$1.50 to US\$3.00) between the hours of 6:30 am to 6:30 pm.²⁴⁹ The city's central business district is a 24 square mile zone through which 450,000 cars pass daily.²⁵⁰ Tracking was implemented by IBM, which designed and operated a fully-automated charging system using advanced optical recognition and radio frequency identification (RFID) technologies.²⁵¹ Fees varied based on time of day, and could be paid through a variety of mechanisms, including purchase at retail establishments, kiosks, and direct withdrawal from the driver's bank account.

Los Angeles HOT Lane Pilot on the I-110 and I-10 Freeway: In November 2012, the city of Los Angeles, California began a one-year pilot HOT road on 11 miles of formerly high

²⁴⁵ Litman, T. Victoria Transport Policy Institute. *London Congestion Pricing*. (November 24, 2011). Accessed July 2013 at: <http://www.vtpi.org/london.pdf>

²⁴⁶ Litman, T., pages 2-3.

²⁴⁷ Litman, T., page 4.

²⁴⁸ Eliasson, J. *Lessons From the Stockholm Congestion Charging Trial*. Centre for Transport Studies, Royal Institute of Technology. Page 8. Accessed July 2013 at: http://vianordica2008.vegagerdin.is/vetenskapligt_webb/Tisdag/Session3_sal3A/Eliasson2.pdf

²⁴⁹ Eliasson, J., Page 8.

²⁵⁰ IBM. *Swedish Road Administration Breaks the Gridlock with a Smart Road Use Management System*. (2005). Page 2. Accessed July 2013 at: <ftp://ftp.software.ibm.com/software/solutions/pdfs/ODB-0150-00.pdf>

²⁵¹ IBM, Page 1.

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occupancy vehicle (HOV) roads on the 110 Freeway. Prices on the road range from \$0.25 to \$1.49 per mile depending on the time of day or amount of traffic.²⁵² In February 2013, a 14 mile stretch of road on the I-10 was converted to HOT lanes.²⁵³ The pilot was implemented to reduce congestion and improve travel time for commuters. Los Angeles Metro issued its second performance report in July of 2013, with the first issued in March 2013, though an independent evaluation of the program's effectiveness will not be issued until mid-2014.²⁵⁴

9.2 GHG Impacts

Road usage pricing policies are often implemented as revenue generation and congestion relief policies, with GHG reduction as a co-benefit. Charging fees in congested areas or during peak travel times incentivizes drivers to limit trips or utilize alternate transportation.

GHG benefits are associated with the reduced VMT that these policies achieve through drivers limiting their number and distance of trips, and using alternate modes of transportation as a result of the policy. No studies were found that listed GHG benefits as the primary cause for implementing a road usage pricing policy, but the reduced VMT achieved through such policies inherently reduce GHG emissions. All of the program data indicated that they were generally successful and generated revenue, though there has been some evidence of traffic leakage onto surrounding, un-priced roads. Table 24, below, further summarizes the available GHG-related information for the London, Stockholm, and Los Angeles programs.

Table 24: GHG Costs and Benefits of Example Road Usage Charge Cordon Programs

London	
Cost of Reductions	The program was estimated to cost £100 million (around US\$155 million) per operating year for the first five years , including startup costs (£36 million or about US\$55 million) and operating costs (£64 million or about US\$100 million). The program was estimated to generate £160 million (about US\$250 million) in revenue (including charge and penalty revenue). ²⁵⁵

²⁵² Los Angeles News. *110 Freeway Toll Lanes Open for Business*. (November 10, 2012). Accessed July 2013 at: http://abclocal.go.com/kabc/story?section=news/local/los_angeles&id=8879676

²⁵³ Los Angeles Metro. Accessed July 2013 at: <http://www.metro.net/projects/expresslanes/>

²⁵⁴ Hymon, S. *Metro releases latest report with preliminary data on ExpressLanes' performance on 10 and 110 freeways*. The Source. (July 22, 2013). Accessed July 2013 at: <http://thesource.metro.net/2013/07/22/metro-releases-latest-report-with-preliminary-data-on-expresslanes-performance-on-10-and-110-freeways/comment-page-2/>

²⁵⁵ Litman, T. Victoria Transport Policy Institute. *London Congestion Pricing*. (November 24, 2011). Page 5. Accessed July 2013 at: <http://www.vtpi.org/london.pdf> (page 5). Using exchange rate of 1£ = 1.56 US\$.

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Volume of Reductions	Emission reductions are not discussed – the program was implemented for revenue generation and congestion reduction.
Programmatic Status	The program is considered effective. A 2011 study estimated that 110,000 motorists a day pay the charge (98,000 individual drivers and 12,000 fleet vehicles), increasingly by mobile phone text message. ²⁵⁶
Emissions Leakage	At the onset of the program, there was concern for traffic spillover onto surrounding roads. There has been 10 percent more traffic on peripheral roads, but this can be mitigated by expanding the pricing area and charging variable fees in the future. ²⁵⁷
Stockholm	
Cost of Reductions	Estimated €84 million (about US\$110 million) generated annually if the trial had continued to be implemented ²⁵⁸
Volume of Reductions	CO ₂ emissions fell by a small percentage of total Stockholm emissions ²⁵⁹ The number of vehicle miles driven in the inner city declined by 15 percent. ²⁶⁰
Programmatic Status	There was a 20-25 percent reduction in traffic in the charged area during charges hours. The number of vehicle miles driven in the inner city declined by 15 percent. ²⁶¹
Emissions Leakage	While some drivers used public transit, others chose to travel during off-peak (non charging) hours. ²⁶² Off-peak travel results in fewer emissions due to less time in traffic and vehicle idling, but does not completely eliminate the emissions from vehicles.
Los Angeles HOT Lane Pilot on the I-110 and I-10 Freeway	
Cost of Reductions	\$0.25 to \$1.40 per mile depending on the time of day and amount of traffic. Estimated average cost for a solo driver using the HOT lanes is \$15 per trip. ²⁶³ Carpoolers do not pay tolls, but must pay for transponders. Preliminary toll revenue for the first six months of the I-110 and the first four months of the I-10 was \$6,966,484. ²⁶⁴
Volume of Reductions	Reduction in GHGs is one of the key metrics that the pilot will be formally evaluated on in accordance with the federal grant ²⁶⁵ None analyzed to date.

²⁵⁶ Litman, T., page 3.

²⁵⁷ Litman, T., page 9.

²⁵⁸ IBM. *Swedish Road Administration Breaks the Gridlock with a Smart Road Use Management System*. (2005). Page 4. Accessed July 2013 at: <ftp://ftp.software.ibm.com/software/solutions/pdfs/ODB-0150-00.pdf>

²⁵⁹ Eliasson, J. Lessons From the Stockholm Congestion Charging Trial. Centre for Transport Studies, Royal Institute of Technology. Page 16. Accessed July 2013 at: http://vianordica2008.vegagerdin.is/vetenskapligt_webb/Tisdag/Session3_sal3A/Eliasson2.pdf (Page 16)

²⁶⁰ Eliasson, J., Page 14.

²⁶¹ Eliasson, J., Page 14.

²⁶² IBM. *Swedish Road Administration Breaks the Gridlock with a Smart Road Use Management System*. (2005). Page 4. Accessed July 2013 at: <ftp://ftp.software.ibm.com/software/solutions/pdfs/ODB-0150-00.pdf>

²⁶³ Nelson, L. *Traffic zips in toll lanes, but slows in free lanes*. Los Angeles Times. (April 9, 2013). Accessed July 2013 at: <http://articles.latimes.com/2013/apr/09/local/la-me-toll-lane-analysis-20130410>

²⁶⁴ https://www.metroexpresslanes.net/en/about/ExpressLanes_Performance_Update_20130719.pdf Page 5

²⁶⁵ https://www.metroexpresslanes.net/en/about/ExpressLanes_Performance_Update_20130719.pdf Page 3

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Programmatic Status	Six months of data are available for the I-110 HOT lanes, and two months of data are available for the I-10 HOT lanes. The program shows increased use of public transit, higher average speeds in the toll lanes than in general traffic lanes and is generating revenue.
Emissions Leakage	None noted.

9.3 Energy and Economic Impacts

As discussed, the economic reasons for implementing a road usage pricing policy are to reduce traffic in highly congested areas and generate revenue. No cases of fuel switching were cited, as the type of fuel used in a vehicle has no impact on the fee assessed, and reductions in fuel used are achieved through reduced VMT associated with the programs.

There were mixed expectations for the impact of the programs on businesses and the economy, with some positive expectations of revenue generation stimulating the economy and funding road construction and maintenance, and some skepticism surrounding whether road pricing would affect businesses in the affected areas. Table 25, below, further summarizes the available energy and economic impact information for the London, Stockholm, and Los Angeles cordon program and pilots.

Table 25: Energy and Economic Impacts of Example Road Usage Charge Cordon Programs

London	
Independence from Fossil Fuels, and Economic Impact	A study of the London trial found that private automobile travel in cities with alternate transportation was more price sensitive than previously believed. ²⁶⁶ This means that implementing a pricing policy on roadways causes a behavioral shift in travelers away from private automobile travel; reducing VMT and fossil fuel consumption.
Impacts on Fuel Choice	None noted.
Opportunity for Investments in Infrastructure and Clean Energy/Energy Efficiency	None noted.
Impact on Different Sectors of the Economy	The London Chamber of Commerce has cited the policy has adversely affected city-center retailers. ²⁶⁷
Stockholm	

²⁶⁶ Litman, T. Victoria Transport Policy Institute. *London Congestion Pricing*. (November 24, 2011). Page 10. Accessed July 2013 <http://www.vtpi.org/london.pdf>

²⁶⁷ Litman, T., page 7.

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Independence from Fossil Fuels, and Economic Impact	Reduced number of vehicles, traffic density and time spent in traffic reduces fossil fuel consumption.
Impacts on Fuel Choice	None noted.
Opportunity for Investments in Infrastructure and Clean Energy/Energy Efficiency	None noted.
Impact on Different Sectors of the Economy	Analysis showed no evidence that businesses inside the cordon were adversely affected by the pricing system. ²⁶⁸
Los Angeles HOT Lane Pilot on the I-110 and I-10 Freeway	
Independence from Fossil Fuels, and Economic Impact	None noted.
Impacts on Fuel Choice	None noted.
Opportunity for Investments in Infrastructure and Clean Energy/Energy Efficiency	None noted.
Impact on Different Sectors of the Economy	Increased construction activity. As part of the HOT lane project, a federal grant of \$210.6 million was issues to fund 59 new clean fuel buses, security and lighting improvements at bus stations, bike lockers, the LA Express Park, the construction of a new bus station, expanded transit signal priority in downtown L.A., as well as the conversion of the HOV lanes to HOT lanes. ²⁶⁹

9.4 Household Impacts and Co-Benefits

Road usage pricing policies are generally criticized as providing preferential access to those who can afford them. To offset anticipated adverse impacts of pricing, programs have offered exemptions, such as the Lidingö exception in Stockholm for an island whose only way in or out was through a charge zone, or low income vouchers, such as those offered in London and in the Los Angeles pilot. Other options include subsidizing alternative modes of transportation, such as carpooling, vanpooling and public transit. Still, some critics argue that these measures are not enough to offset the costs, and that these policies disproportionately favor those who can afford to take advantage of the priced roads. Table 26 below, further summarizes the available household impact and co-benefit information for the London, Stockholm, and Los Angeles programs and pilots.

²⁶⁸ Eliasson, J. Lessons From the Stockholm Congestion Charging Trial. Centre for Transport Studies, Royal Institute of Technology. Page 16. Accessed July 2013 at: http://vianordica2008.vegagerdin.is/vetenskapligt_webb/Tisdag/Session3_sal3A/Eliasson2.pdf

²⁶⁹ https://www.metroexpresslanes.net/en/about/ExpressLanes_Performance_Update_20130719.pdf Page 3

Table 26: Household Impacts and Co-Benefits of Example Road Usage Charge Cordon Programs

London	
Effect on Household Consumption and Spending	None quantified.
Measures to Mitigate to Low-income Populations, or Economic Impact	Motorists with disabilities are exempt from payment, and residents within the priced area receive substantial discounts. Still, critics argue that the fee is double charging on top of registration and fuel taxes, and that exemptions for disabled persons and discounts for city-center residents are not available to lower income residents. ²⁷⁰
Significant Co-benefits	Revenue generation and congestion relief.
Stockholm	
Effect on Household Consumption and Spending	None noted.
Measures to Mitigate to Low-income Populations, or Economic Impact	Exceptions provided for the island of Lidingö, where the only road that connected the island to the rest of Sweden runs through downtown Stockholm ²⁷¹
Significant Co-benefits	Reduced congestion. Exposure to exhaust emissions in the inner city declined by 10-15 percent. ²⁷²
Los Angeles HOT Lane Pilot on the I-110 and I-10 Freeway	
Effect on Household Consumption and Spending	None noted.
Measures to Mitigate to Low-income Populations, or Economic Impact	Los Angeles County families with three or more members making less than \$37,000 annually are eligible for discounts. ²⁷³ As of July 2013, \$75,000 in toll credits had been issued to 3,000 equity plans for low-income commuters. ²⁷⁴ Income distribution of those using the program is relatively normal around a central \$50,000-\$74,900 income level. ²⁷⁵
Significant Co-benefits	Reduced travel time and congestion relief for participants, revenue generation

²⁷⁰ Litman, T. Victoria Transport Policy Institute. *London Congestion Pricing*. (November 24, 2011). Page 9. Accessed July 2013 <http://www.vtpi.org/london.pdf>

²⁷¹ Eliasson, J. Lessons From the Stockholm Congestion Charging Trial. Centre for Transport Studies, Royal Institute of Technology. Page 9. Accessed July 2013 at: http://vianordica2008.vegagerdin.is/vetenskapligt_webb/Tisdag/Session3_sal3A/Eliasson2.pdf

²⁷² Eliasson, J., Pages 15-16.

²⁷³ Los Angeles News. *110 Freeway Toll Lanes Open for Business*. (November 10, 2012). Accessed July 2013 at: http://abclocal.go.com/kabc/story?section=news/local/los_angeles&id=8879676

²⁷⁴ https://www.metroexpresslanes.net/en/about/ExpressLanes_Performance_Update_20130719.pdf Page 14

²⁷⁵ https://www.metroexpresslanes.net/en/about/ExpressLanes_Performance_Update_20130719.pdf Page 13

10 VMT Charging and Pay-as-you-Drive (PAYD)

Policy Definition	Targeted Sector or Emissions
<p>There are several proposed GHG policies that attempt to reduce vehicle miles traveled (VMT) by private vehicles as a result of pricing each mile driven, including a VMT fee associated with pay-as-you-drive (PAYD) insurance and VMT fees implemented as an alternative to a gas tax. These two policy types are very different in how they are implemented and to whom they apply; however as a GHG policy, both are targeting reduced VMT by putting a price on vehicle trips, so the effectiveness of either is based on the elasticity of demand from this mechanism of cost. As such, a key policy design element for GHG reductions would be to maximize the information feedback to the driver on how much each mile costs. As far as policy implementation, the policies are quite different, as one applies to private insurance companies, whereas the other applies to all drivers and is administered through an overseeing government entity or third-party government supported entity. Both of these two unique policy examples are grouped in this document because of their similarities in how they might affect GHG emissions, as discussed further below.</p>	Transportation
GHGs and Costs	
<ul style="list-style-type: none"> Pricing strategies to reduce VMT are often implemented as revenue generation and congestion relief policies, with GHG reduction as an ancillary benefit. Data from MBUF program pilots have shown that VMT charges can be implemented to replace the gas tax as the principal revenue source for road funding.²⁷⁶ 	
Implementation Issues and Lessons Learned	
<ul style="list-style-type: none"> Depending on pricing implementation, potential to disproportionately impact low income users; mitigation for impacts should be considered When considering road pricing options, the potential to limit mobility for non-discretionary users (freight and trucking industry, businesses using the highway system to provide goods and services), should be mitigated 	
Costs and Benefits to Consumers	Costs and Benefits to Businesses
<ul style="list-style-type: none"> Congestion relief Decrease in travel times Decrease in traffic accidents due to reduced number of vehicle trips Toll prices are direct costs to Washington travelers Consumer cost savings are case-specific, and will depend on the amount of travel, among other factors Depending on pricing implementation, potential to disproportionately impact low income users; mitigation for impacts should be considered Revenue raised increases the State's ability to maintain, operate and expand the transportation system 	<ul style="list-style-type: none"> Potential adverse impact on sales for some city-center retailers (for cordon policies), though the net impact is expected to be negligible²⁷⁷ Revenue raised increases the State's ability to maintain, operate and expand the transportation system

²⁷⁶ Whitty, J. 2013. Page 45. Accessed July 2013 at:

http://www.oregon.gov/ODOT/HWY/RUFPP/docs/RUCPilotPrelimFind_Feb13.pdf

²⁷⁷ Danna, et. al. *A Benefit-Cost Analysis of Road Pricing in Downtown Seattle*. Evans School Review. Vol. 2, Num. 1, Spring 2012. Page 37. Accessed September 2013 at: <https://depts.washington.edu/esreview/wordpress/wp-content/uploads/2012/12/ESR-2012-A-Benefit-Cost-Analysis-of-Road-Pricing-in-Downtown-Seattle.pdf>

VMT charging policies charge drivers according to the number of miles traveled. Such policies may be implemented for revenue generation and/or congestion relief, with GHG reduction as a co-benefit. As cars increasingly become more fuel efficient, state and local governments receive less revenue from the traditional fossil fuel taxes to spend on road infrastructure maintenance and development. Road usage policies are often used to tax mileage traveled to account for highly fuel efficient vehicles, or vehicles that require no fuel. In addition, road usage charges can be used as congestion relief mechanisms, charging fees in congested areas or during peak travel times to incentivize drivers to limit trips or utilize alternate transportation.

These policies can be implemented as either as a government tolling or Mileage Based User Fee (MBUF), or through the use of PAYD insurance policies, as discussed below.

Government VMT Fees: As cars increasingly become more fuel efficient, state and local governments receive less revenue from the traditional fossil fuel taxes to spend on road infrastructure maintenance and development. A MBUF can be used to tax mileage traveled rather than fuel consumed, to account for highly fuel efficient vehicles, or vehicles that require no fuel. Under government VMT programs, a fee is assessed based on the number of vehicle miles that are traveled. Often, this fee replaces the gasoline tax to generate revenue for road infrastructure maintenance and development in response to increasing fuel efficiency in vehicles which is causing declining revenues. Under this system, users are paying for their actual use of the transportation system, rather than paying based on the quantity of fuel that their vehicles consume. These programs can be as simple as a flat fee charged per mile based on odometer readings, or tiered fees based on distance, location, and other factors. Implementation can be done through various mechanisms, including pay-at-the-pump and onboard vehicle monitoring devices.

The Rocky Mountain Institute estimates that there is a nationwide potential for between a 12 and 15 percent reduction in VMT with the implementation of a VMT tax, at a present value cost (in 2009 dollars) of \$168 billion for the entire country.²⁷⁸

Pay-As-You-Drive Insurance, or Usage-Based Insurance: Under PAYD insurance, the cost of insuring a motor vehicle is contingent on the type of vehicle, time, distance traveled, location, and behavior.^{279,280} Pay-as-you-drive insurance is currently offered in over 35 states, including

²⁷⁸ Rocky Mountain Institute. *Summary of U.S. VMT Reduction Strategies*. (2011). Accessed July 2013 at: http://www.rmi.org/RFGGraph-Summary_of_US_VMT_reduction_strategies

²⁷⁹ Orenstein, B. *Who's doing what? The rise of usage-based auto insurance*. Insure. (September 4, 2012). Accessed July 2013 at: <http://www.insure.com/car-insurance/usage-based-insurance-update.html>

²⁸⁰ National Association of Insurance Commissioners and the Center for Insurance Policy and Research. *Usage-Based Insurance and Telematics*. (last updated May 29, 2013). Accessed July 2013 at: http://www.naic.org/cipr_topics/topic_usage_based_insurance.htm

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Washington, in a variety of forms, through a variety of providers. “Low mileage discounts” are available in Washington State through several providers.²⁸¹

A 2008 Brookings study found that upon implementing nationwide pay-as-you-go insurance policies for all drivers, “[...] driving would decline by 8 percent nationwide, netting society the equivalent of about \$50 billion to \$60 billion a year by reducing driving-related harms. This driving reduction would reduce carbon dioxide emissions by 2 percent and oil consumption by about 4 percent. To put it in perspective, it would take a \$1-per-gallon increase in the gasoline tax to achieve the same reduction in driving.”²⁸²

Beginning in 2012, pay-as-you-go became available in Oregon.²⁸³ Progressive Universal Insurance Co. was the pilot company in Oregon²⁸⁴, with seven companies now offering it in the State.²⁸⁵ The policy is voluntary, and offers the benefit of reduced insurance cost to safe or infrequent drivers (up to a 45 percent reduction, depending on driving patterns), with the tradeoff of reduced privacy (mileage and location are tracked via a GPS-enabled device that also detects erratic braking and high speeds for some insurance companies).

In March of 2012, HB 2361 was signed by the Governor of Washington, after having passed the House 73-23 and Senate 38-10, with an effective date of June 7, 2012. The bill exempts certain information on usage-based insurers (including the usage-based component of the insurance rate) and users (including names and individual identification data of the insured) from public inspection during state filings. The bill also protects the insured from having data on their location collected by the insurance company without disclosure to and consent from the insured.²⁸⁶ There are no known remaining legal barriers to PAYD insurance in Washington, and therefore no actions that the State can take to encourage its use.

10.1 Existing Policies

This section analyzes Oregon’s Road Usage Charge Pilot Program, which represents a regional example of a pilot government MBUF. Following the pilots discussed below, in July 2013,

²⁸¹ Pay-As-You-Go Insurance from Onstar/National General Insurance -- Low-Mileage Discount Offered in 35 States. Accessed July 2013 at: <http://www.lowmileagediscount.com/what-is-payg/lmd-states.asp>

²⁸² Bordoff, J. and P. Noel. *Pay-As-You-Drive Auto Insurance: A Simple Way to Reduce Driving-Related Harms and Increase Equity*. The Brookings Institution. (July 2008). Accessed July 2013 at: <http://www.brookings.edu/research/papers/2008/07/payd-bordoffnoel>

²⁸³ The Sightline Institute. *Pay-As-You-Drive Car Insurance*. Accessed July 2013 at: <http://www.sightline.org/research/payd/>

²⁸⁴ Oregon Environmental Council. *Pay-As-You-Drive Insurance*. Accessed July 2013 at: <http://www.oeonline.org/our-work/climate-protection/transportation/other-transportation-solutions/payd>

²⁸⁵ Hunsberger, B. *Pay-as-you-drive car insurance: Trade your privacy for a price break?* The Oregonian. (March 2, 2013). Accessed July 2013 at: http://www.oregonlive.com/finance/index.ssf/2013/03/pay-as-you-go_car_insurance_tr.html

²⁸⁶ Engrossed Substitute House Bill 2361. <http://apps.leg.wa.gov/documents/billdocs/2011-12/Pdf/Bills/House%20Passed%20Legislature/2361-S.PL.pdf>

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Oregon became the only state to allow drivers to choose between a gallon-based tax and a MBUF, allowing up to 5,000 drivers to enlist in a voluntary program.²⁸⁷

State of Oregon Road Usage Charge Pilot Program: The State of Oregon Department of Transportation conducted a Road User Fee Pilot Project in 2007 in Portland,²⁸⁸ and a Road Usage Charge Pilot Project in 2012.

The 2007 study involved three volunteer test groups: VMT, rush hour, and control. The VMT group was assessed a flat charge per mile driven, the rush hour group was assessed a premium on the fee in congested zones during peak times, and the control group paid the standard fuel tax throughout the 10 month trial.²⁸⁹ Mileage tracking devices were fit onto all vehicles in the study, and participants used a “pay-at-the-pump” method for payment, where the devices communicated the charge to the gas pump when participants refueled their vehicles.

The 2012 study, which ran from November 2012 through February 2013, was refined based on lessons learned in the 2007 pilot, and focused on vehicles getting greater than 55 miles per gallon.²⁹⁰ The high MPG rating for vehicles in the pilot was designed into the program to show the impact of replacing the state gas tax for highly fuel-efficient vehicles.²⁹¹ The 2012 study tested five mileage data collection and reporting plans: unlimited mileage for a flat annual or monthly fee, basic reporting of mileage without vehicle location data (one managed by the Oregon Department of Transportation and one managed by a private provider), advanced reporting of miles with vehicle location (managed by a private provider), and smartphone reporting of mileage reporting and vehicle location data (managed by a private provider). The study included 45 participants from Oregon, 21 from Washington, and 27 from Nevada.²⁹²

10.2 GHG Impacts

GHG benefits are associated with the reduced VMT that these policies achieve through drivers limiting their number and distance of trips, and using alternate modes of transportation as a result of the policy. No studies were found that listed GHG benefits as the primary cause for implementing a PAYD policy, but the reduced VMT achieved through such policies inherently

²⁸⁷ Vock, D. *State gas tax could be replaced by mileage tax*. USA Today. August 1, 2013. Accessed August 2013 at: <http://www.usatoday.com/story/news/nation/2013/08/01/oregon-gas-mileage-tax/2608067/>

²⁸⁸ Whitty, J. *Oregon's Mileage Fee Concept and Road User Fee Pilot Program*. Oregon Department of Transportation. (November 2007). Accessed July 2013 at: http://www.oregon.gov/ODOT/HWY/RUFPP/docs/RUFPP_finalreport.pdf

²⁸⁹ Whitty, J. *Oregon's Mileage Fee Concept and Road User Fee Pilot Program*. Oregon Department of Transportation. (November 2007). Page 42. Accessed July 2013 at: http://www.oregon.gov/ODOT/HWY/RUFPP/docs/RUFPP_finalreport.pdf

²⁹⁰ Oregon Department of Transportation. *Road Usage Charge Pilot Program*. Accessed July 2013 at: <http://www.oregon.gov/ODOT/HWY/RUFPP/Pages/rucpp.aspx>

²⁹¹ Oregon Department of Transportation. *Oregon's Road Usage Charge Program Frequently Asked Questions*. Accessed September 2013 at: <http://roadchargeoregon.org/frequently-asked-questions/>

²⁹² Whitty, J. *Road Usage Charge Pilot Program Preliminary Findings*. Oregon Department of Transportation. (February 2013). Page 7. Accessed July 2013 at: http://www.oregon.gov/ODOT/HWY/RUFPP/docs/RUCPilotPrelimFind_Feb13.pdf (page 7)

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reduce GHG emissions. Table 27, below, summarizes the available GHG-related information for the Oregon VMT charge pilot. There can be significant capital costs involved in starting a mileage-based charging program, but as the vehicle fleet becomes more fuel efficient, the revenue generated through mileage charges would surpass the revenue generated through gasoline taxes. In general, the Oregon pilot program was viewed as a success based on the objectives of the program design, which included ease of implementation and use, and potential for public adoption.

Table 27: GHG Costs and Benefits of the Oregon VMT Charging Pilot

Oregon	
Cost of Reductions	For the 2007 pilot, the total estimated start-up cost of the mileage fee at the state level was estimated to be \$32,801,000 over a 20 year period. ²⁹³ For the 2012 pilot, the cost to users was \$0, and approximately 44 total minutes over the trial. ²⁹⁴
Volume of Reductions	None noted – the pilot was a technology feasibility assessment rather than a broad study of behavioral changes in response to the pricing mechanism.
Programmatic Status	Yes – the study found that existing technology used in new ways, a mileage fee could be implemented to replace the gas tax as the principal revenue source for road funding. The 2007 pilot study found that 91 percent of study participants would pay the road usage fee rather than a gas tax if given the option. ²⁹⁵ The 2012 study successfully met its objectives of demonstrating an easy-to-use system with multiple implementation choices and multiple vendors. ²⁹⁶
Emissions Leakage	None noted.

10.3 Energy and Economic Impacts

Table 28, below, summarizes the available energy and economic impact information for the Oregon PAYD pilot. Findings from the Oregon pilot study did not note any impacts on fuel choice or energy independence, but did note that the impact on fuel distributors and gas stations (when implementing a pay-at-the-pump program) undertook additional administrative burdens, which were easily surmountable, as the technology was essentially automated. No cases of fuel switching associated with VMT charging policies were cited, as the type of fuel used in a vehicle

²⁹³ Whitty, J. *Oregon's Mileage Fee Concept and Road User Fee Pilot Program*. Oregon Department of Transportation. (November 2007). Pages 31 and 61. Accessed July 2013 at:

http://www.oregon.gov/ODOT/HWY/RUFPP/docs/RUFPP_finalreport.pdf

²⁹⁴ Whitty, J. *Road Usage Charge Pilot Program Preliminary Findings*. Oregon Department of Transportation. (February 2013). Page 29. Accessed July 2013 at:

http://www.oregon.gov/ODOT/HWY/RUFPP/docs/RUCPilotPrelimFind_Feb13.pdf

²⁹⁵ www.oregon.gov/ODOT/HWY/RUFPP/docs/RUFPP_finalreport.pdf (page vi)

²⁹⁶ Whitty, J. 2013. Page 45. Accessed July 2013 at:

http://www.oregon.gov/ODOT/HWY/RUFPP/docs/RUCPilotPrelimFind_Feb13.pdf

has no impact on the fee assessed, and reductions in fuel used are achieved through reduced VMT associated with the programs.

Table 28: Energy and Economic Impacts of the Oregon VMT Charging Pilot

Oregon	
Independence from Fossil Fuels, and Economic Impact	None noted – the pilot was a technology feasibility assessment rather than a broad study of behavioral changes in response to the pricing mechanism.
Impacts on Fuel Choice	None noted.
Opportunity for Investments in Infrastructure and Clean Energy/Energy Efficiency	None noted.
Impact on Different Sectors of the Economy	Distributors and gas stations bear some new accounting burdens, administration is essentially automated and can be integrated easily into existing transaction processes. ²⁹⁷

10.4 Household Impacts and Co-Benefits

Table 29, below, summarizes the available household impact and co-benefit information for the Oregon MBUF pilot. Findings of the Oregon pilot programs indicated minimal impact on household consumption, that the fees were perceived as equitable, and that mileage-based fees will generate more revenue for the government than the fuel tax as the vehicle fleet becomes more fuel efficient.

Table 29: Household Impacts and Co-Benefits of the Oregon VMT Charging Pilot

Oregon	
Effect on Household Consumption and Spending	None noted – the pilot was a technology feasibility assessment rather than a broad study of behavioral changes in response to the pricing mechanism.
Measures to Mitigate to Low-income Populations, or Economic Impact	A road usage charge is generally perceived as being equitable by the participants in study ²⁹⁸

²⁹⁷ Whitty, J. *Oregon's Mileage Fee Concept and Road User Fee Pilot Program*. Oregon Department of Transportation. (November 2007). Page vii. Accessed July 2013 at: www.oregon.gov/ODOT/HWY/RUFPP/docs/RUFPP_finalreport.pdf

²⁹⁸ Whitty, J. 2013. Page 6. Accessed July 2013 at: http://www.oregon.gov/ODOT/HWY/RUFPP/docs/RUCPilotPrelimFind_Feb13.pdf

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Significant Co-benefits	Revenue generation: results from the 2012 pilot showed that the road usage charge generates as much or more revenue when compared with the fuel tax, so long as the fleet to which it applies has a fuel economy of at least 19.2 mpg ²⁹⁹
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²⁹⁹ Whitty, J. 2013. Page 30. Accessed July 2013 at:
http://www.oregon.gov/ODOT/HWY/RUFPP/docs/RUCPilotPrelimFind_Feb13.pdf

11 Electric Vehicle (EV) Purchase Incentives and Infrastructure Support

Policy Definition	Targeted Sector or Emissions
EV purchase incentives and infrastructure support are programs providing funding to EV vehicle and charging technology development to increase the penetration of EVs into the automotive market. Types of incentives include but are not limited to grants, loans, tax exemptions, and purchase vouchers	Transportation
GHGs and Costs	
<ul style="list-style-type: none"> • Oregon Commercial Electric Trucks: Oregon has invested approximately \$4 million and estimates reductions of 4,768 mtCO₂e per year. • California Clean Vehicle Rebate Program (CVRP): The CVRP has distributed 30,399 rebates for a total of over \$66 million for eligible vehicles, amounting to reductions of approximately 57,758 mtCO₂e per year. • The EV Project: Total costs of the program in Washington for 2013 are estimated at \$1.2 million with reductions equating to 1,593 mtCO₂e per year. 	
Implementation Issues and Lessons Learned	
<ul style="list-style-type: none"> • Potential interactions with a low carbon fuel standard. • Increases in EV incentives can increase consumer purchasing of EVs. • Customer incentives may help meet emissions and Zero Emissions Vehicle (ZEV) mandate goals. Since the current sales tax exemption in Washington applies only to vehicles fueled solely by electricity, the proposed incentives may shift purchasing to a higher proportion of transitional zero emissions vehicles such as plug-in hybrids. • Need for additional commercial/public infrastructure incentives to support EV adoption and market penetration. 	
Costs and Benefits to Consumers	Costs and Benefits to Businesses
<ul style="list-style-type: none"> • Public health benefits from reduced emissions. • Increase in vehicle prices as a result of incremental vehicle technology prices. California has estimated that the average new vehicle purchase costs will increase by about \$1,900.³⁰⁰ • Increased purchase costs are expected to be offset by reduced operating costs, ultimately resulting in a net savings of up to \$4,000 over the lifetime of the vehicles.³⁰¹ 	<ul style="list-style-type: none"> • Opportunities for engineering and manufacturing jobs within the states incentivizing EVs.³⁰² • Shifts away from petroleum-based fuels (gasoline and diesel) will have negative impacts on businesses involved in oil production, refining and transportation. • As a result of potentially increasing electricity sales from increased EV charging, there may be shifts toward electricity produced in-state that will have positive impacts on businesses involved in the electricity sector.

³⁰⁰ p.147 of the CARB study referenced in the ZEV section:

<http://www.arb.ca.gov/regact/2012/leviighg2012/levisor.pdf>.

³⁰¹ p. 209 of the CARB study referenced in the ZEV

section <http://www.arb.ca.gov/regact/2012/leviighg2012/levisor.pdf>.

³⁰² (governor's plan page 5: [http://opr.ca.gov/docs/Governor's_Office_ZEV_Action_Plan_\(02-13\).pdf](http://opr.ca.gov/docs/Governor's_Office_ZEV_Action_Plan_(02-13).pdf))

APPENDIX A: Literature review of existing policies

Fuel consumption in the transportation sector is the largest source of emissions in the State of Washington. Transportation activities resulted in 42.2 mmtCO₂e of emissions, or 44 percent of total emissions in Washington in 2010. The largest share of emissions from this source resulted from consumption of on-road gasoline and diesel (21.9 and 8 mmtCO₂e, respectively), making incentives to purchase electric vehicles (EVs) and fund infrastructure construction and charging support an important step to reducing on-road GHG emissions.

Currently, the State of Washington offers certain tax exemptions and demonstration grants to incentivize the use of EVs, and requires any regional planning organization containing a county with a population over 1 million within its jurisdiction to collaborate with the State and local governments to promote electric vehicle use.³⁰³ Because of the relatively clean electricity fuel mix in Washington State due to the large presence of hydropower, transferring transportation energy from fossil-based fuels to electric power could significantly aid in reducing GHG emissions from the transportation sector.

Washington has been a leader in facilitating the early adoption of EVs. This section summarizes examples of EV programs that focus on vehicle purchase and infrastructure investment and incentives. Market penetration and adoption of EVs can be further increased through incentives such as loans, grants and rebates for charging technology and infrastructure development to minimize the investment cost of purchasing and using EVs for consumers. As Federal and other states' incentives for some programs such as EVs may be receding, there may be potential for other types of policies that can influence individual consumer adoption rates and fleet purchases.³⁰⁴

11.1 Existing Policies

This section analyzes existing policies implemented in other jurisdictions which target incentives to purchase and fund infrastructure for EVs. Each of the programs described below was considered as examples of EV purchase and charging technology and infrastructure incentive programs relevant to Washington. Many of these programs have not publically provided emissions reduction data and those that do are generally preliminary results or estimates. The studies listed below provided quantitative data, and will be further analyzed in the following subsections:

- Oregon Commercial Electric Truck Incentive Program (CETIP)
- California Clean Vehicle Rebate Project (CVRP)
- The EV Project

³⁰³ U.S. DOE EERE. Alternative Fuels Data Center (Washington- and policy- specific database query). Online at: [http://www.afdc.energy.gov/laws/search?p=search&location\[\]=WA&tech\[\]=3270&search_button=y](http://www.afdc.energy.gov/laws/search?p=search&location[]=WA&tech[]=3270&search_button=y)

³⁰⁴ Lee van der Voo, Electric car industry leaders told to focus on policy, Sustainable Business Oregon, December 6, 2012, Accessed August 2013 at <http://sustainablebusinessoregon.com/articles/2012/12/electric-car-industry-leaders-told-to.html?page=all>

Drive Oregon³⁰⁵ - **Commercial Electric Truck Incentive Program (CETIP):** Through the Commercial Electric Truck Incentive Program (CETIP), the Oregon Department of Transportation (ODOT) provides vouchers to reimburse commercial fleets for \$20,000 for each qualified zero emission truck purchased. Vehicles eligible for this program must be new, titled and licensed in Oregon, have a gross vehicle weight rating of over 10,000 pounds, and must replace an existing diesel vehicle. Federal Congestion Mitigation and Air Quality (CMAQ) funds totaling \$4 million have been approved for the CETIP, and the ODOT estimates that they will distribute 200 vouchers within the first year of the program. Trucks must be used primarily in CMAQ-eligible areas of Oregon.^{306,307,308}

California Clean Vehicle Rebate Project (CVRP): The purpose of the CVRP is to encourage and accelerate zero- and near-zero emission, on-road light-duty vehicle deployment and technology innovation. The CVRP provides rebates of up to \$2,500 for California purchasers or lessees of light-duty zero-emission vehicles (ZEVs) and plug-in hybrid electric vehicles (PHEVs). A minimum of 93 percent of the CVRP funds go to rebates for purchasers of *new* eligible on-road vehicles.³⁰⁹

The EV Project: Managed by Ecotality, and sponsored by the U.S. DOE, the EV Project offered Electric Vehicle Supply Equipment (EVSE) at no charge to Nissan LEAF and Chevrolet Volt customers in exchange for collecting vehicle and charge information and data. The program provided a Blink wall charger at no cost and up to \$400 towards the charger installation cost. Although not a specific jurisdictional program, the EV Project publishes comprehensive data on avoided GHG emissions and cost reductions from EVs, generated significant lessons learned on user behavior and charger installations, and was active in cities in Washington, Oregon, California, Arizona, Illinois, Texas, Tennessee, Georgia, Pennsylvania, New Jersey, and Washington D.C. The EV Project was scheduled to conclude in June 2013, and Ecotality filed for bankruptcy on September 16, 2013, as a result of insufficient sales, liquidity constraints, and difficulty obtaining the long-term financing.³¹⁰ No information was available to determine whether the bankruptcy was a result of poor management of the program or business struggles with other aspects of the business's engagement in the electric car industry. One of the most valuable aspects of the EV Project may be the data it collected from nationwide installations, users' charging habits, and partnerships with commercial host sites, which is available for public access.

³⁰⁵ Drive Oregon. Online at: <http://driveoregon.org/>

³⁰⁶ Oregon Department of Transportation CTEIP Presentation (June 22, 2012). Online at: <http://www.oregon.gov/ODOT/HWY/OIPP/docs/cetiproadmap5.pdf>

³⁰⁷ Drive Oregon. Commercial Electric Truck Incentive Program. (August 30, 2012). Online at: <http://driveoregon.org/press/commercial-electric-truck-incentive-program/>

³⁰⁸ U.S. DOE EERE. Alternative Fuels Data Center (Oregon CTEIP). Online at: <http://www.afdc.energy.gov/laws/law/OR/10112>

³⁰⁹ Center for Sustainable Energy California. Clean Vehicle Rebate Project (CVRP). Online at: <http://energycenter.org/index.php/incentive-programs/clean-vehicle-rebate-project>

³¹⁰ Reuters. Ecotality, an electric car charger maker, files for bankruptcy September 17, 2013. Accessed September 2013 at <http://www.reuters.com/article/2013/08/12/us-ecotality-bankruptcy-idUSBRE97B0K320130812>

Delaware Vehicle-to-Grid Energy Credit: This policy encourages the development of vehicle-to-grid technologies, which can provide peak power supply to utilities from individual vehicles. In this program, retail electricity customers with at least one grid-integrated EV can qualify to receive kilowatt-hour credits for the energy discharged to the grid from their EV's battery at the same price rate that the customer pays to charge that battery. Because this energy credit is offered at the same price rate that the customer pays to charge that battery, so the customer can bank revenue while their car is discharging to the grid. As defined in the Delaware State Code, a grid-integrated EV is a battery-powered motor vehicle with the ability for two-way power flow between the vehicle and the electric grid as well as communications hardware and software that allow for external control of battery charging and discharging.³¹¹ Depending on the energy market and how long the vehicle owner can allow the car to discharge energy to the grid, annual revenue generated for the customer could range from \$400-\$5,000,³¹² although this opportunity comes at the expense of battery degradation effects associated with vehicle-to-grid services.³¹³

Electric Vehicles in Illinois: The Illinois Department of Commerce and Economic Opportunity (DCEO) offers rebates to governments, businesses, educational institutions, non-profits, and individual residents toward the installation of Level 2 EV charging stations. These rebates cover 50 percent of equipment and installation costs up to the following amounts:

- \$3,750 per networked³¹⁴ single station and \$7,500 per networked dual station.
- \$3,000 per non-networked single station and \$6,000 per non-networked dual station.

The maximum rebate award is \$49,000, or 50 percent of the total project cost for up to 15 stations, whichever is less. Furthermore, the Illinois DCEO incentivizes EV adoption through grant funds to support EV supply equipment production to expand and develop related businesses such as component manufacturers.³¹⁵ Other potential future Illinois EV charging and infrastructure support incentives recommended by the Illinois Electric Vehicle Advisory Council include:

- A program for multi-unit residential buildings to install EV charging stations in shared or common area parking spaces.

³¹¹ State of Delaware Online Delaware Code: Title 26, Chapter 10, Section 1014g. Online at: <http://delcode.delaware.gov/title26/c010/index.shtml>

³¹² University of Delaware. The Grid-Integrated Vehicle with Vehicle to Grid Technology. Online at: <http://www.udel.edu/V2G/QandA.html>

³¹³ C. Waldron and P. Kobylarek, The Reality of Electric Vehicles and the Grid, Electric Light & Power, January 1, 2011, accessed August 2013 at <http://www.elp.com/articles/print/volume-89/issue-1/sections/the-reality-of-electric-vehicles-and-the-grid.html>

³¹⁴ Note that a networked station indicates that the station has a cellular or internet connection.

³¹⁵ Illinois Department of Commerce and Economic Opportunity. Electric Vehicles in Illinois. Online at: http://ildceo.net/dceo/bureaus/energy_recycling/ev.htm

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- State agencies providing local grants to install public EV charging stations in strategic locations in communities to facilitate EV charging and maximize usage by local commuters and other travelers.³¹⁶

Texas River Cities: The Texas River Cities Plug-in EV (PEV) Initiative managed by Austin Energy, is a regional planning effort to promote clean and efficient electric drive cars for Central Texas, one of many Electric Vehicle Community Readiness Projects across the country. Sponsored by the U.S. DOE with Recovery Act funds, the Texas River Cities has developed an infrastructure readiness plan to provide tools and templates to strategically accelerate the adoption of EVs.³¹⁷ Austin Energy offers residential customers and PEV owners a rebate of 50 percent of the cost of the purchase and installation of a Level 2 (240V) Charging Station. The maximum rebate amount for a Level 2 (240V station) is \$1,500.³¹⁸

Oregon Alternative Fuel Tax Credit: The Oregon Department of Energy (ODOE) has up to \$20 million available in the current biennium for business tax incentives for public transit services and AFV and EV infrastructure. AFV and EV infrastructure that qualify for the transportation incentives include projects such as electric vehicle charging, blender pumps and CNG systems. Project applicants can apply for a maximum credit of up to 35 percent of eligible project costs.³¹⁹ Oregon also offers residential energy tax credits equal to 25 percent of project costs not to exceed \$750. Eligible projects include electric vehicle charging stations, vehicle-attached charging stations and compressed natural gas fueling stations.³²⁰

11.2 GHG Impacts

The Oregon CETIP program analyzed here mostly pertains to providing cleaner vehicle alternatives to diesel trucks and buses. This program would be particularly relevant to reducing emissions in Washington's urban areas where commercial truck and public bus transit are high. The Oregon data provide preliminary estimates of the benefit of the program. In contrast to the Oregon program, the California CVRP and the EV Project are programs targeted at vehicles generally in the residential sector rather than the commercial sector. As of August 12, 2013, the California CVRP alone had distributed 30,399 rebates for a total of over \$66 million for eligible vehicles.³²¹ Using methods and assumptions from The EV Project's 2012 report, *Lessons*

³¹⁶ Illinois Electric Vehicle Advisory Council. Final Report to Governor Pat Quinn and the Illinois General Assembly (December 2011). Online at: <http://www.ildceo.net/NR/rdonlyres/96A30601-9C66-44DD-91BF-416E080AF9C8/0/20111230EVACFinalReport.pdf>

³¹⁷ Texas River Cities Plug-in Electric Vehicle Initiative. Online at: <http://texasrivercities.com/>

³¹⁸ Austin Energy Special Offers for PEV Owners. Online at: <http://www.austinenergy.com/About%20Us/Environmental%20Initiatives/plugin%20Partners/drivers.htm>

³¹⁹ Oregon Department of Energy. Online at: <http://www.oregon.gov/energy/BUSINESS/Incentives/Pages/EIP-Trans.aspx>

³²⁰ Oregon Department of Energy. Online at: <http://www.oregon.gov/ENERGY/TRANS/Pages/hybridcr.aspx>

³²¹ Center for Sustainable Energy California. Clean Vehicle Rebate Project (CVRP) Statistics. Online at: <http://energycenter.org/programs/clean-vehicle-rebate-project/cvrp-project-statistics>

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*Learned – The EV Project Greenhouse Gas (GHG) Avoidance and Cost Reduction*³²², SAIC quantified the cost of emissions reductions and the volume of reductions based on California’s estimated yearly avoided emissions per vehicle of 1.9 mtCO_{2e}.³²³

It is important to note that the Oregon CETIP quantifies emissions reductions as tailpipe reductions while the California CVRP and the EV Project employed a method to quantify reductions over the full life cycle of the EVs. Table 30 summarizes the costs and reductions from Oregon’s CETIP, the CVRP, and the EV Project³²⁴.

Table 30: GHG Costs and Benefits of EV purchase and charging technology and infrastructure support incentives.

Oregon Commercial Electric Truck Incentive Program (CETIP) ³²⁵	
Cost of Reductions	Oregon has invested approximately \$4 million. ³²⁶
Volume of Reductions	4,768 mtCO_{2e} per year. ³²⁷
Programmatic Status	No data readily available.
Emissions Leakage	Displaced emissions were not quantified; however, there are likely displaced tailpipe emissions. EVs have no tailpipe emissions, but they do run on electricity, so tailpipe emissions are displaced to the electricity sector. According to a 2012 study by the EV Project, the overall U.S. emissions displaced to the electricity sector are lower than those from vehicle tailpipes, yielding a net reduction of GHG emissions. ³²⁸
California Clean Vehicle Rebate Program (CVRP)	
Cost of Reductions	The CVRP has distributed 30,399 rebates for a total of over \$66 million for eligible vehicles. ³²⁹
Volume of Reductions	57,758 mtCO_{2e} per year. ³³⁰

³²² The EV Project. *Lessons Learned – The EV Project Greenhouse Gas (GHG) Avoidance and Cost Reduction* (July 2012). Prepared for the U.S. Department of Energy Award #DE-EE0002194. Online at: <http://www.theevproject.com/cms-assets/documents/106077-891082.ghg.pdf>

³²³ Ibid (page 13).

³²⁴ Note that this analysis focuses solely on data for Washington State. The EV Project has participants from multiple states including Washington, Oregon, California, Arizona, Texas, Tennessee, Illinois, Georgia, Pennsylvania, New Jersey, and Washington D.C.

³²⁵ The Oregon CETIP is replacing 200 diesel trucks with electric trucks.

³²⁶ Oregon Department of Transportation CTEIP Presentation (June 22, 2012). Online at: <http://www.oregon.gov/ODOT/HWY/OIPP/docs/cetiproadmap5.pdf> (Slide 10).

³²⁷ Ibid. Note that Slide 10 is assumed to have been reported in short tons, so short tons were converted to metric tons to get the volume of reductions.

³²⁸ The EV Project. *Lessons Learned – The EV Project Greenhouse Gas (GHG) Avoidance and Cost Reduction* (July 2012). Prepared for the U.S. Department of Energy Award #DE-EE0002194. Online at: <http://www.theevproject.com/cms-assets/documents/106077-891082.ghg.pdf> (page 20)

³²⁹ Center for Sustainable Energy California. *Clean Vehicle Rebate Project (CVRP) Statistics*. Online at: <http://energycenter.org/programs/clean-vehicle-rebate-project/cvrp-project-statistics>

³³⁰ Volume of Reductions = Total number of CVRP Rebates (30,399) x California Avoided Emissions Factor (1.9 mtCO_{2e})

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Programmatic Status	According to a May 2013 survey of CVRP recipients, EV customers are highly satisfied with their decision to drive EVs and use their plug-in EVs as their primary mode of transportation. Furthermore, 95 percent of the survey respondents mentioned that the CVRP was an important motivating factor in their decision to purchase an EV. The survey also mentions that driver satisfaction is high, but the satisfaction with public charging infrastructure is low. ³³¹
Emissions Leakage	Displaced emissions were not quantified; however, there are likely displaced tailpipe emissions. EVs have no tailpipe emissions, but they do run on electricity, so tailpipe emissions are displaced to the electricity sector. According to a 2012 study by the EV Project, the overall U.S. emissions displaced to the electricity sector are lower than those from vehicle tailpipes, yielding a net reduction of GHG emissions. ³³²
The EV Project (Washington)³³³	
Cost of Reductions	Cumulative enrollment through the second quarter of 2013 in Washington was 1,062 vehicles. Each vehicle received a charger valued at \$700 and up to \$400 installation costs. Total costs are therefore estimated at \$1.2 million.
Volume of Reductions	The EV Project estimates that Washington participants reduced emissions by 1.5 mtCO ₂ e annually per vehicle ³³⁴ , which equates to 1,593 mtCO₂e cumulatively per year.
Programmatic Status	The program is considered a success thus far with a total of over 8,100 vehicles participating nationwide in the program, 8,200 residential chargers installed and 3,750 public commercial chargers installed. ³³⁵
Emissions Leakage	According to a 2012 study by the EV Project, overall U.S. emissions displaced to the electricity sector are lower than those from vehicle tailpipes, yielding a net reduction of GHG emissions. ³³⁶

³³¹ Center for Sustainable Energy California. Clean Vehicle Rebate Project (CVRP) May 2013 Survey. Online at: <http://energycenter.org/programs/clean-vehicle-rebate-project/vehicle-owner-survey/may-2013-survey>

³³² The EV Project. Lessons Learned – The EV Project Greenhouse Gas (GHG) Avoidance and Cost Reduction (July 2012). Prepared for the U.S. Department of Energy Award #DE-EE0002194. Online at: <http://www.theevproject.com/cms-assets/documents/106077-891082.ghg.pdf> (page 20)

³³³ Data for the EV Project relates to GHG avoidance and cost savings due to charging and driving EVs as opposed to internal combustion engine vehicles (ICEVs) (i.e., the CO₂e avoided by charging an EV rather than using gasoline in an ICEV). In a 2012 EV Project study, the Nissan LEAF represents the EV while a mid-sized 28.6 mile per gallon vehicle represents the ICEV. The study assumed that a Nissan LEAF would drive 12,000 miles and use 4,080 kWh of energy per year, and calculated the avoided emissions results for each state in the U.S. based on state-specific grid emissions factors. Fuel cost savings were estimated using the average cost per gallon of gasoline (on May 1, 2012) and the average U.S. electricity cost per kWh.

³³⁴ The EV Project. Lessons Learned – The EV Project Greenhouse Gas (GHG) Avoidance and Cost Reduction (July 2012). Prepared for the U.S. Department of Energy Award #DE-EE0002194. Online at: <http://www.theevproject.com/cms-assets/documents/106077-891082.ghg.pdf> (Adapted from Table 3-5, pages 13-15)

³³⁵ The EV Project: EVSE and Vehicle Usage Report 2nd Quarter of 2013. Online at: <http://www.theevproject.com/cms-assets/documents/127233-901153.q2-2013-rpt.pdf> (page 2)

³³⁶ The EV Project. Lessons Learned – The EV Project Greenhouse Gas (GHG) Avoidance and Cost Reduction (July 2012). Prepared for the U.S. Department of Energy Award #DE-EE0002194. Online at: <http://www.theevproject.com/cms-assets/documents/106077-891082.ghg.pdf> (page 20)

11.3 Energy and Economic Impacts

In considering energy and economic impacts for the programs analyzed here, a major effect of switching to cleaner fuels such as electricity is the reduction in fuel use. As seen in Table 31 below, the Oregon CETIP estimates annual diesel savings of over 540,000 gallons³³⁷. The California CVRP and the EV Project could displace approximately 12 million gallons³³⁸ and 445,000³³⁹ gallons of gasoline, respectively. With increases in the number of EV charging facilities and infrastructure, there will likely be increased market penetration of EVs, further reducing dependence on fossil fuels. Greater market penetration will also likely advance economic development and jobs in a variety of sectors, from manufacturing and transportation to agriculture and the service industry. Error! Reference source not found. outlines the energy and economic impacts associated with EV purchase and charging technology and infrastructure support incentives.

Table 31: Energy and Economic Impacts of EV purchase and fueling technology and infrastructure support incentives.

Oregon Commercial Electric Truck Incentive Program (CETIP)	
Independence from Fossil Fuels, and Economic Impact	Estimated 540,780 gallons of petroleum diesel saved annually. ³⁴⁰
Impacts on Fuel Choice	Use of electricity in place of petroleum.
Opportunity for Investments in Infrastructure and Clean Energy/Energy Efficiency	Engineering, construction, installation, and maintenance of fuel infrastructure, especially along highly travelled corridors and at participating vehicle purchaser station (for example, bus fleet garage).
Impact on Different Sectors of the Economy	No data readily available.
California Clean Vehicle Rebate Program (CVRP)	
Independence from Fossil Fuels, and Economic Impact	The 2012 EV Project estimates that 420 gallons of gasoline are displaced annually per vehicle. ³⁴¹ That is a total of approximately 12 million gallons of gasoline displaced in California. ³⁴²

³³⁷James, A. 2012. *Oregon Commercial Electric Truck Incentive Program: EV Roadmap 5 Conference Presentation*. Online at: <http://www.oregon.gov/ODOT/HWY/OIPP/docs/cetiproadmap5.pdf>

³³⁸ Assuming that each rebate from the CVRP is provided for one car, meaning that there are 30,399 vehicles represented in this program. 30,399 vehicles x 420 gallons displaced per vehicle = 12,159,600 gallons displaced.

³³⁹ In the 2012 EV Project study referenced above, the Nissan LEAF represents the EV while a mid-sized 28.6 mile per gallon vehicle represents the ICEV. The study assumed that a Nissan LEAF would drive 12,000 miles per year. Thus, 12,000 miles/28.6 miles per gallon = 420 gallons of gasoline displaced per vehicle.

³⁴⁰ Oregon Department of Transportation CTEIP Presentation (June 22, 2012). Online at: <http://www.oregon.gov/ODOT/HWY/OIPP/docs/cetiproadmap5.pdf> (Slide 10)

³⁴¹ In a 2012 EV Project study referenced above, the Nissan LEAF represents the EV while a mid-sized 28.6 mile per gallon vehicle represents the ICEV. The study assumed that a Nissan LEAF would drive 12,000 miles per year. Thus, 12,000 miles/28.6 miles per gallon = 420 gallons of gasoline displaced per vehicle.

³⁴² Assuming that each rebate from the CVRP is provided for one car, meaning that there are 30,399 vehicles represented in this program. 30,399 vehicles x 420 gallons displaced per vehicle = 12,159,600 gallons displaced.

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Impacts on Fuel Choice	Use of electricity in place of petroleum.
Opportunity for Investments in Infrastructure and Clean Energy/Energy Efficiency	There will be opportunities for engineering, construction, installation, and maintenance of public charging infrastructure. According to the CVRP 2013 survey, respondent satisfaction for public charging was low ³⁴³ , so there could be improvements and additions to public charging infrastructure.
Impact on Different Sectors of the Economy	No data readily available.
The EV Project (Washington)	
Independence from Fossil Fuels, and Economic Impact	Using assumptions from the 2012 EV Project study, there is likely to be 420 gallons of gasoline displaced per vehicle annually. ³⁴⁴ With 1,062 vehicles in Washington for this program, that is over 445,000 gallons of gasoline displaced, with estimated cost savings of \$1,437 per vehicle and \$1.5 million total in Washington.
Impacts on Fuel Choice	For the EV Project as a whole (all states participating), consumption of over 2.9 million gallons of gasoline has been avoided. ³⁴⁵
Opportunity for Investments in Infrastructure and Clean Energy/Energy Efficiency	There will be opportunities for engineering, construction, installation, and maintenance of public charging infrastructure. Increased electricity demand from EV charging may spur new opportunities to support clean energy in the electricity sector as clean energy would help reduce overall lifecycle emissions.
Impact on Different Sectors of the Economy	No data readily available.

11.4 Household Impacts and Co-benefits

As a result of decreased fuel use and mobile emissions, the adoption of EVs generates benefits to public health. With the cleaner technologies of new or retrofitted vehicles, the Oregon CETIP estimated reductions in pollutants such as particulate matter (PM_{2.5} and PM₁₀), nitrogen oxide (NO_x), hydrocarbons, and carbon monoxide (CO). Air quality can improve with decreases in these pollutants, potentially improving the health and surrounding environments truck drivers, and employees of the companies and jurisdictions participating in these types of commercial EV programs. Table 32 shows the reductions to the pollutants quantified for each program.

³⁴³ Center for Sustainable Energy California. Clean Vehicle Rebate Project (CVRP) May 2013 Survey. Online at: <http://energycenter.org/programs/clean-vehicle-rebate-project/vehicle-owner-survey/may-2013-survey> (page 19)

³⁴⁴ In the 2012 EV Project study referenced above, the Nissan LEAF represents the EV while a mid-sized 28.6 mile per gallon vehicle represents the ICEV. The study assumed that a Nissan LEAF would drive 12,000 miles per year. Thus, 12,000 miles/28.6 miles per gallon = 420 gallons of gasoline displaced per vehicle.

³⁴⁵ The EV Project: EVSE and Vehicle Usage Report 2nd Quarter of 2013. Online at: <http://www.theevproject.com/cms-assets/documents/127233-901153.q2-2013-rpt.pdf> (page 3)

Table 32: Household Impacts and Co-Benefits of EV purchase and charging technology and infrastructure support incentives.

Oregon Commercial Electric Truck Incentive Program (CETIP)	
Effect on Household Consumption and Spending	No data readily available.
Measures to Mitigate to Low-income Populations, or Economic Impact	No data readily available.
Significant Co-benefits	Potential reduction in adverse effects to public health from diesel emissions. Annual reductions include: PM_{2.5} = 1.6 metric tons NO_x = 50.2 metric tons Hydrocarbons = 2.9 metric tons CO = 15.6 metric tons³⁴⁶
California Clean Vehicle Rebate Program (CVRP)	
Effect on Household Consumption and Spending	No data readily available.
Measures to Mitigate to Low-income Populations, or Economic Impact	No data readily available.
Significant Co-benefits	No data readily available.
The EV Project (Washington)	
Effect on Household Consumption and Spending	The EV Project estimates a net savings of \$1,437 per vehicle³⁴⁷ and \$1,526,328 cumulatively³⁴⁸ for residents in Washington as a result of energy cost savings.
Measures to Mitigate to Low-income Populations, or Economic Impact	No data readily available.
Significant Co-benefits	No data readily available.

³⁴⁶ Oregon Department of Transportation CTEIP Presentation (June 22, 2012). Online at: <http://www.oregon.gov/ODOT/HWY/OIPP/docs/cetiproadmap5.pdf> (Slide 10)

³⁴⁷ The EV Project. Lessons Learned – The EV Project Greenhouse Gas (GHG) Avoidance and Cost Reduction (July 2012). Prepared for the U.S. Department of Energy Award #DE-EE0002194. Online at: <http://www.theevproject.com/cms-assets/documents/106077-891082.ghg.pdf> (Adapted from Table 4-1, pages 16-18).

³⁴⁸ Total Annual EV Savings = Annual EV Savings per Individual Vehicle (\$1,437) x Number of Vehicles Enrolled in EV Project as of the Second Quarter in 2013 (1,062 vehicles in Washington)

12 Alternative Fuel Vehicle (AFV) Purchase Incentives and Infrastructure Support, including Advanced Biofuels

Policy Definition	Targeted Sector or Emissions
AFV purchase incentives and infrastructure support are programs providing funding to AFV vehicle and fueling technology development to increase the penetration of AFVs into the automotive market. Types of incentives include but are not limited to grants, loans, tax exemptions, and purchase vouchers.	Transportation
GHGs and Costs	
<ul style="list-style-type: none"> • New York City Clean-fueled Bus Program: Program costs are approximately \$10.2 million with estimated GHG reductions 144,434 mtCO₂e over the lifetime of vehicles. • Illinois Green Fleet Program: Grant money spending is at \$148,472 with estimated reductions at 3,705 mtCO₂e per year. • Western New York Biodiesel: The total cost of the project to date is \$420,000, and has led to a 15 percent reduction in CO₂ emissions from their original diesel emissions baseline. • USDA Advanced Biofuel Payment Program: In June 2013, the USDA announced up to \$98.6 million to support the production of advanced biofuels, and an opportunity for eligible producers to submit applications. No emissions reduction data was available at the time of this research. • California Energy Commission AFV Program: Research indicates that the CEC awarded around \$140 million to biofuels through the first for investment plans as of December 2011. The CEC estimates there to be GHG emissions reductions anywhere from between 1,326,694 mtCO₂e and 6,682,472 mtCO₂e by 2020. 	
Implementation Issues and Lessons Learned	
<ul style="list-style-type: none"> • Potential interactions with the low carbon fuel standard. • Increases in AFV incentives can increase consumer purchasing of AFVs. • Need for additional commercial/public infrastructure incentives to support AFV adoption and market penetration. 	
Costs and Benefits to Consumers	Costs and Benefits to Businesses
<ul style="list-style-type: none"> • Public health benefits from reduced diesel emissions. • Consumers receive incentives for their purchase and use of AFVs, generally reducing the up-front cost of the vehicle. Consumers may incur the cost of interest on loans received to purchase an AFV. • Fuel prices may fluctuate based on development of refining capacity for in-state biofuel production or purchase out-of-state alternative fuels, among other factors. 	<ul style="list-style-type: none"> • Opportunities for engineering and manufacturing jobs within the State of Washington. • Shifts away from petroleum-based fuels (e.g., gasoline and diesel) will have negative impacts on businesses involved in oil production, refining and transportation. • Significant increases in biofuel production will positively impact biofuel production, refining, and transportation along with the farming and agricultural sectors of the economy as a result of additional demand for fuel feedstock

As mentioned in the previous EV section, fuel consumption in the transportation sector is the largest source of emissions in the State of Washington, making incentives to purchase alternative fuel vehicles (AFVs) and fund associated infrastructure construction and fueling support an

important step to reducing on-road GHG emissions. Currently, Washington provides certain tax exemptions for AFVs, and provides loans and grants for research and development in the production of alternative fuels.³⁴⁹ Fuels powering AFVs are less carbon-intensive than traditional fossil fuels, allowing AFV fuel use to reduce GHG emissions from the transportation sector. Market penetration and adoption of EVs and AFVs can be further increased through incentives such as loans, grants and rebates for fueling technology and infrastructure development to minimize the investment cost of purchasing and using EVs and AFVs for consumers.

12.1 Existing Policies

This section analyzes existing policies implemented in other jurisdictions which target incentives to purchase and fund infrastructure for AFVs. Each of the programs described below were considered as examples of AFV purchase incentive and fueling technology and infrastructure programs relevant to Washington.³⁵⁰ Many of these programs have not publically provided emissions reduction data and those that do are generally preliminary results or estimates. The studies listed below provided quantitative data, and will be further analyzed in the following subsections:

- New York City Transit Authority Clean-fueled Bus Program
- Illinois Green Fleet Program
- Western New York Biofuel Initiative
- The USDA Advanced Biofuel Payment Program
- California Alternative and Renewable Fuel and Vehicle Technology Program

New York Alternative Fuel and Advanced Vehicle Funding³⁵¹ and Heavy-Duty Alternative Fuel and Advanced Vehicle Purchase Vouchers^{352,353}: The New York State Energy Research and Development Authority (NYSERDA) AFV Program provides financial assistance and technical information to encourage fleets in the State of New York to purchase EVs and AFVs and install fueling facilities or charging stations. AFVs and EVs that qualify for funding use natural gas, propane, and electricity, including certain hybrid-electric vehicles. Projects that have benefitted from this program include the New York City Transit Authority Clean-fueled

³⁴⁹U.S. DOE EERE. Alternative Fuels Data Center (Washington- and policy- specific database query). Online at: [http://www.afdc.energy.gov/laws/search?p=search&location\[\]=WA&search_button=y](http://www.afdc.energy.gov/laws/search?p=search&location[]=WA&search_button=y)

³⁵⁰ Note that the Oregon Alternative Fuel Loans policy originally to be considered under this section of the policy analysis was switched to the AFV/EV infrastructure section as that program focuses more on infrastructure than vehicle purchase.

³⁵¹ New York State Energy Research & Development Authority (NYSERDA). Alternative Fuel Vehicle Program. Online at: <http://www.nyserda.ny.gov/BusinessAreas/Energy-Innovation-and-Business-Development/Research-and-Development/Transportation/Alternative-Fuel-Vehicles.aspx>

³⁵² NYSERDA. New York Truck - Voucher Incentive Program (NYT-VIP). Online at: <https://truck-vip.ny.gov/index.php>

³⁵³ It is important to note that the New York program includes incentives for both EVs and AFVs, but has been placed under this section due to the tendency of the programs to focus on AFVs.

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Bus Program, the Clean Air School Bus Program, the New York Truck Voucher Incentive Program, and Albany International Airport natural gas airport fleet project.³⁵⁴

Illinois Green Fleets: The Illinois Green Fleets program began in 2000, and gives recognition to corporate and small business, government, and other fleets in Illinois that are excellent examples of “greening” their fleet operation. The Green Fleets program is an umbrella for other initiatives such as the Alternative Fuel Rebates Program and the Illinois Clean Diesel Grant Program. The Alternative Fuel Rebates Program offers rebates to anyone for using E85 or biodiesel fuels (20 percent blend or higher), for purchasing a new AFV, or for converting a conventional vehicle to alternate fuel (e.g., E85, B20, natural gas, propane, hydrogen, and electric). The Clean Diesel Grant Program focuses on diesel upgrades and conversion of engines to increase efficiency in mainly buses and trucks.³⁵⁵

Western New York Biodiesel Initiative: The NYSERDA AFV Program provides financial assistance and technical information to encourage fleets in the State of New York to purchase AFVs and install fueling facilities or charging stations.³⁵⁶ NYSERDA provided roughly \$420,000 dollars to biodiesel infrastructure and fuel deployment projects in Western New York. \$60,000 goes to biodiesel infrastructure like tanks and dispensers while the remaining \$360,000 is allocated for purchasing 1.2 million gallons of B-20 fuels for programs that support this initiative.³⁵⁷

The USDA Advanced Biofuel Payment Program: This program, within the USDA’s Rural Development Office, provides payments³⁵⁸ to biofuel producers to support and expand production of advanced biofuels.³⁵⁹ Under this program, payments are made to eligible producers based on the amount of advanced biofuels produced from renewable biomass, other than corn kernel starch. Biofuel can be made from a variety of non-food sources, including waste products. Examples of eligible feedstocks include, but are not limited to, crop residue, animal, food and yard waste material, vegetable oil, and animal fat. To be eligible, producers must enter into a contract with USDA Rural Development for advanced biofuels production and submit records to document their production.³⁶⁰ Through this and other programs, USDA is working to support the

³⁵⁴ Examples of NYSERDA AFV program case studies online at: <http://www.nyserda.ny.gov/Publications/Case-Studies/AFV-Case-Studies.aspx>

³⁵⁵ Illinois Environmental Protection Agency. Illinois Green Fleets. Online at: <http://www.illinoisgreenfleets.org/>

³⁵⁶ New York State Energy Research & Development Authority (NYSERDA). Alternative Fuel Vehicle Program. Online at: <http://www.nyserda.ny.gov/BusinessAreas/Energy-Innovation-and-Business-Development/Research-and-Development/Transportation/Alternative-Fuel-Vehicles.aspx>

³⁵⁷ New York State Energy Research & Development Authority (NYSERDA). Western New York Biodiesel Initiative Case Study. Online at: <http://www.nyserda.ny.gov/Publications/Case-Studies/AFV-Case-Studies.aspx>

³⁵⁸ One payment is based on actual production and another payment is based on incremental production.

³⁵⁹ U.S. Department of Agriculture Advanced Biofuel Payment Program. Online at: http://www.rurdev.usda.gov/BCP_Biofuels.html

³⁶⁰ U.S. Department of Agriculture Rural Development Energy Programs Fact Sheet. Online at: http://www.rurdev.usda.gov/SupportDocuments/RD_energy_factsheet_1928_2009_final.pdf

research, investment and infrastructure necessary to build a strong biofuels industry that creates jobs and broadens the range of feedstocks used to produce renewable fuel.

California Alternative and Renewable Fuel and Vehicle Technology Program (ARFVT)³⁶¹: This program provides funding of up to \$100 million annually, leveraging public and private investment to develop and deploy clean, efficient, and low-carbon alternative fuels and technologies.³⁶² California's objective is to produce 20 percent of biofuels used in state by 2010, 40 percent by 2020, and 75 percent by 2050. The CEC developed and adopted three investment plans since 2008 that guide more than \$361 million in total awards for the first four fiscal years of the ARFVT Program, of which \$114.9 million was allocated to biofuels. Using funds from this first investment plan (fiscal years 2008-09 and 2009-10), plus a portion of funds from the second investment plan (fiscal year 2010-2011), the Energy Commission funded 86 projects totaling \$197.4 million to date, of which \$64 million was awarded to biofuels.³⁶³ The most recent investment plan, covering fiscal years 2012-2013, allocates \$20 million and \$21.5 million to alternative fuel production and alternative fuel infrastructure, respectively³⁶⁴.

Utah AFV and Fueling Infrastructure Grants and Loans: The Utah Clean Fuels Vehicle Grant and Loan Program is funded through the Clean Fuels and Vehicle Technology Fund, and provides grants and loans to assist businesses and government entities in alleviating the following costs:

- Converting vehicles to operate on clean fuels.
- Incremental cost of purchasing original equipment manufactured clean fuel vehicles.
- Retrofitting diesel vehicles with U.S. EPA verified closed crankcase filtration devices, diesel oxidation catalysts, and/or diesel particulate filters.
- Fueling equipment for public and private sector business and government vehicles (these grants require federal and non-federal matching funds).³⁶⁵

Accomplishments to date include the purchase of eight CNG refuse trucks and two CNG transit buses, and the conversion of five vehicles to run on a cleaner fuel.³⁶⁶

³⁶¹ California Energy Commission. California's Alternative & Renewable Fuel & Vehicle Technology Program. Online at: <http://www.energy.ca.gov/drive/>

³⁶² California Energy Commission. Background Information: 2013-2014 Investment Plan for the Alternative and Renewable Fuel and Vehicle Technology Program. Online at: <http://www.energy.ca.gov/2012-ALT-2/background.html>

³⁶³ California Energy Commission. Benefits report for the Alternative and Renewable Fuel and Vehicle Technology Program (December 2011). Online at: <http://www.energy.ca.gov/2011publications/CEC-600-2011-008/CEC-600-2011-008-SD.pdf> (page 20)

³⁶⁴ California Energy Commission. 2012- 2013 Investment Plan Update for the Alternative and Renewable Fuel and Vehicle Technology Program (May 2012). Online at: <http://www.energy.ca.gov/2012publications/CEC-600-2012-001/CEC-600-2012-001-CMF.pdf> (page 4)

³⁶⁵ U.S. DOE EERE. Alternative Fuels Data Center (Utah Laws and Incentives for Vehicle Drivers and Owners). Online at: <http://www.afdc.energy.gov/laws/laws/UT/user/3260>

Texas Clean Transportation Triangle (CTT) Program (Natural Gas): A program of the Texas Emissions Reduction Plan (TERP), the CTT program provides grants to create natural gas fueling stations along interstate highways.³⁶⁷ The purpose of this program is to develop a foundation for a natural gas vehicle market that is self-sustaining through strategic distribution of fueling facilities and the expansion of natural gas use in larger vehicles. LNG stations are eligible for up to \$250,000 grants while CNG stations can receive a maximum of \$100,000 in funding. Total funding available for the program amounted to \$1.8 million as of January 2013.³⁶⁸

12.2 GHG Impacts

The New York and Illinois programs analyzed here mostly pertain to providing cleaner vehicle alternatives to diesel trucks and buses. These programs would be particularly relevant to reducing emissions in Washington’s urban areas where commercial truck and public bus transit are high. The Illinois data provide preliminary estimates of the benefit of the program while the New York data come from a case studies completed by the New York City Transit Authority. In contrast to these three programs, the USDA and California programs mainly target advanced biofuel production and AFV technology development. Table 30 summarizes the costs and reductions of these five AFV programs as there was no data for the other programs described above.

Table 33. GHG Costs and Benefits of AFV purchase and fueling technology and infrastructure support incentives.³⁶⁹

New York City Transit Authority Clean-fueled Bus Program ³⁷⁰	
Cost of Reductions	Program costs are approximately \$10.2 million. ³⁷¹

³⁶⁶ Utah Department of Environmental Quality. Division of Air Quality, Mobile Sources and Transportation Section. Clean Fuel Vehicle Grant and Loan Program. Online at: <http://www.cleanfuels.utah.gov/grants/grantsintro.htm>

³⁶⁷ Texas Commission on Environmental Quality. Clean Transportation Triangle (CTT) Program. Online at: <http://www.tceq.texas.gov/airquality/terp/ctt.html/>

³⁶⁸ Texas Commission on Environmental Quality. Clean Transportation Triangle (CTT) Program: Solicitation 582-13-31009 Presentation at the CTT Grant Workshop (January 23, 2013). Online at: <http://www.tceq.texas.gov/airquality/terp/ctt.html/>

³⁶⁹ It is assumed that the New York and Illinois programs quantified GHG emissions reductions as tailpipe reductions, but the case studies did not indicate the type of reductions quantified. Furthermore, it is assumed that the CEC program calculated reductions on a life-cycle basis as the report alluded to “biofuel production projects” and not just reductions from vehicles.

³⁷⁰ The New York City Clean-fueled Bus Program purchased 192 compressed natural gas and 91 diesel hybrid-electric buses.

³⁷¹ NYSERDA/New York City Clean-Fueled Bus Program Case Study: Hybrid-electric and Natural Gas Buses. Online at: <http://www.nysenda.ny.gov/Publications/Case-Studies/AFV-Case-Studies.aspx>

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Volume of Reductions	144,434 mtCO₂e over lifetime of vehicles. ³⁷² Note that other programs estimate volume of emissions reductions on an annual basis, but this estimate is over the lifetime of the vehicles. NYSERDA did not provide the estimated lifetime of these vehicles.
Programmatic Status	Yes, according to the case study "drivers, passengers, and the public now perceive hybrid-electric and CNG buses positively, and drivers report that passengers are impressed with the new technology." A goal was public acceptance of the new technology. ³⁷³
Emissions Leakage	No anticipated displacement.
Illinois Green Fleet: Clean Diesel Grant Program ³⁷⁴	
Cost of Reductions	A 2009 grant application to U.S. EPA pegs spending at \$148,472. ³⁷⁵
Volume of Reductions	3,705 mtCO₂e per year. ³⁷⁶
Programmatic Status	20 projects have been completed through 2012. ³⁷⁷
Emissions Leakage	No anticipated displacement.
Western New York Biodiesel Initiative	
Cost of Reductions	The total cost of the project to date is \$420,000 , and has led to a 15 percent reduction in CO ₂ emissions from their original diesel emissions baseline. ³⁷⁸
Volume of Reductions	Although no quantitative data are available, analysis by NYSERDA estimates a reduction of 15 percent in CO ₂ emissions from their original diesel emissions baseline due to the program. ³⁷⁹
Programmatic Status	Yes, 160 heavy-duty diesel vehicles, including buses and dump trucks, are participating in the program. At the time of the case study, over 615,000 gallons of B20 had been used in these vehicles that have traveled more than 2.6 million miles. Furthermore, there was a seamless transition to the B20 fuel, no reported loss in engine power, and fuel economy consistent with straight diesel. ³⁸⁰
Emissions Leakage	No anticipated displacement.

³⁷² Ibid.

³⁷³ Ibid.

³⁷⁴ The Illinois Green Fleet program converted roughly 270 vehicles (trucks, buses, and locomotives) to clean fuels.

³⁷⁵ Illinois Green Fleets: Green Jobs, Clean Diesel, Clean Air. 2009. *A Grant Application submitted to the U.S. Environmental Protection Agency-Region 5 by the Illinois Environmental Protection Agency, the American Lung Association of Illinois, and the Respiratory Health Association of Metropolitan Chicago on behalf of the Illinois Clean Diesel Workgroup*, (page 10). Online at:

<http://www.recovery.illinois.gov/documents/Applications/IEPA%2066.039%20National%20Clean%20Diesel.pdf>.

³⁷⁶ Ibid. Note that this number was converted from short tons to metric tons.

³⁷⁷ Illinois Green Fleets: Illinois 2012 DERA Grant Projects Completed (April 8, 2013). Online at:

<http://www.illinoisgreenfleets.org/2012-dera-grant-projects.pdf>

³⁷⁸ NYSERDA Western New York Biodiesel Initiative Case Study. Online at:

<http://www.nyserdera.ny.gov/Publications/Case-Studies/AFV-Case-Studies.aspx>

³⁷⁹ Ibid.

³⁸⁰ Ibid.

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USDA Advanced Biofuel Payment Program	
Cost of Reductions	To date, over 280 producers in 45 states and territories have received \$192.5 million in payments. ³⁸¹ In June 2013, the USDA announced up to \$98.6 million to support the production of advanced biofuels, and an opportunity for eligible producers to submit applications. ³⁸²
Volume of Reductions	Data not readily available.
Programmatic Status	This program is considered a success and has supported the production of more than 3 billion gallons of advanced biofuel and the equivalent of more than 36 billion kilowatt hours of electric energy. ³⁸³
Emissions Leakage	There were no quantitative data readily available.
CEC Alternative and Renewable Fuel and Vehicle Technology Program	
Cost of Reductions	As of December 2011, \$64 million was awarded to biofuels through the first two investment plans, and an additional \$76 million is being allocated to biofuels and alternative fuel production in the 3 rd and 4 th investment plans.
Volume of Reductions	The CEC estimates annual carbon emission reductions from biofuel production projects by 2020 to be between 1,326,694 mtCO₂e and 6,682,472 mtCO₂e. ³⁸⁴
Programmatic Status	The CEC finds that the economic and environmental benefits resulting from the first round of ARFVT Program funding awards to be a success and demonstrates measurable progress toward achieving multiple state policy goals. ³⁸⁵
Emissions Leakage	There were no quantitative data readily available, but biofuel production can cause some emissions from land use and processing.

12.3 Energy and Economic Impacts

In considering energy and economic impacts for the programs analyzed here, a major effect of switching to cleaner fuels such as biodiesel or natural gas is the reduction in fuel use. Each of these programs provides substantial displacement of petroleum fuels to advanced biofuels. Table

³⁸¹ U.S. Department of Agriculture. News Release: USDA Announces A Notice of Contract Proposals to Support Advanced Biofuels Production (June 11, 2013). Online at:

<http://www.usda.gov/wps/portal/usda/usdahome?contentid=2013/06/0123.xml>

³⁸² U.S. Department of Agriculture. News Release: USDA Announces A Notice of Contract Proposals to Support Advanced Biofuels Production (June 11, 2013). Online at:

<http://www.usda.gov/wps/portal/usda/usdahome?contentid=2013/06/0123.xml> or <http://www.gpo.gov/fdsys/pkg/FR-2013-06-11/pdf/2013-13778.pdf>

³⁸³ . Department of Agriculture. News Release: Producers in 38 States Receive Funds to Support Advanced Biofuel Production. Online at: http://www.rurdev.usda.gov/STELPRD4020614_print.html

³⁸⁴ California Energy Commission. Benefits report for the Alternative and Renewable Fuel and Vehicle Technology Program (December 2011). Online at: <http://www.energy.ca.gov/2011publications/CEC-600-2011-008/CEC-600-2011-008-SD.pdf> (page 26)

³⁸⁵ Ibid (page 1).

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34 presents the jurisdictional data on the energy and economic impacts of AFV purchase and charging technology and infrastructure support incentives.

Table 34. Energy and Economic Impacts of AFV purchase and charging technology and infrastructure support incentives.

New York City Transit Authority Clean-fueled Bus Program	
Independence from Fossil Fuels, and Economic Impact	Estimated 10,250,968 gallons of diesel displaced over the lifetime of the vehicles. ³⁸⁶
Impacts on Fuel Choice	Use of natural gas in place of petroleum.
Opportunity for Investments in Infrastructure and Clean Energy/Energy Efficiency	Engineering, construction, installation, and maintenance of fuel infrastructure.
Impact on Different Sectors of the Economy	No data readily available.
Illinois Green Fleet: Clean Diesel Grant Program	
Independence from Fossil Fuels, and Economic Impact	Estimated 403,837 gallons of diesel saved per year. ³⁸⁷
Impacts on Fuel Choice	No data readily available.
Opportunity for Investments in Infrastructure and Clean Energy/Energy Efficiency	Opportunities for jobs to retrofit vehicles with new technology. Estimated creation of 123 new jobs from multiple projects under this program. ³⁸⁸
Impact on Different Sectors of the Economy	No data readily available.
Western New York Biodiesel Initiative	
Independence from Fossil Fuels, and Economic Impact	The Initiative anticipates increased independence from fossil fuels with an estimated 123,000 gallons of diesel displaced by the B20 fuel. ³⁸⁹

³⁸⁶ NYSDERDA/New York City Clean-Fueled Bus Program Case Study: Hybrid-electric and Natural Gas Buses. Online at: <http://www.nyserda.ny.gov/Publications/Case-Studies/AFV-Case-Studies.aspx>

³⁸⁷ Illinois Green Fleets: Green Jobs, Clean Diesel, Clean Air. 2009. *A Grant Application submitted to the U.S. Environmental Protection Agency-Region 5 by the Illinois Environmental Protection Agency, the American Lung Association of Illinois, and the Respiratory Health Association of Metropolitan Chicago on behalf of the Illinois Clean Diesel Workgroup*, (page 10). Online at: <http://www.recovery.illinois.gov/documents/Applications/IEPA%2066.039%20National%20Clean%20Diesel.pdf>

³⁸⁸ Illinois Green Fleets: Green Jobs, Clean Diesel, Clean Air. 2009. *A Grant Application submitted to the U.S. Environmental Protection Agency-Region 5 by the Illinois Environmental Protection Agency, the American Lung Association of Illinois, and the Respiratory Health Association of Metropolitan Chicago on behalf of the Illinois Clean Diesel Workgroup*, (page 4). Online at: <http://www.recovery.illinois.gov/documents/Applications/IEPA%2066.039%20National%20Clean%20Diesel.pdf>

³⁸⁹ NYSDERDA Western New York Biodiesel Initiative Case Study. Online at: <http://www.nyserda.ny.gov/Publications/Case-Studies/AFV-Case-Studies.aspx>

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Impacts on Fuel Choice	Use of biodiesel in place of diesel for participants.
Opportunity for Investments in Infrastructure and Clean Energy/Energy Efficiency	\$60,000 has been invested in biodiesel infrastructure like tanks and dispensers, and \$360,000 is allocated for purchasing 1.2 million gallons of B20 fuels for programs that support this initiative. ³⁹⁰
Impact on Different Sectors of the Economy	There is the potential for engineering, construction, installation, and general maintenance of fuel infrastructure.
USDA Advanced Biofuel Payment Program	
Independence from Fossil Fuels, and Economic Impact	Reduces dependence on fossil fuels.
Impacts on Fuel Choice	Data not readily available.
Opportunity for Investments in Infrastructure and Clean Energy/Energy Efficiency	The on-road diesel market alone is about 35 billion to 40 billion gallons per year ³⁹¹ , indicating that there is the potential for the growing biodiesel market.
Impact on Different Sectors of the Economy	Advanced biofuel industry supports economic development and jobs in a variety of sectors, from manufacturing and transportation to agriculture and service industry.
CEC Alternative and Renewable Fuel and Vehicle Technology Program	
Independence from Fossil Fuels, and Economic Impact	The CEC estimates that by 2020 biodiesel and ethanol production will displace petroleum anywhere from 9.4-378.1 million gallons and 14-59.2 million gallons annually, respectively. ³⁹²
Impacts on Fuel Choice	Increased use of biodiesel and ethanol in place of diesel and gasoline.
Opportunity for Investments in Infrastructure and Clean Energy/Energy Efficiency	In December 2011, CEC published projected job benefits from the entire ARFVT Program, and estimates that 5,400 jobs will be created to help implement their Program-funded projects, of which 1,912 are anticipated to be short-term jobs (1-18 months) and 3,482 are anticipated to be long-term jobs. ³⁹³
Impact on Different Sectors of the Economy	Job creation will be in manufacturing, construction, engineering as well as operation and maintenance. The CEC estimates about 1,500 jobs created in fuel production alone by the commercialization phase. ³⁹⁴

12.4 Household Impacts and Co-benefits

³⁹⁰ Ibid.

³⁹¹ The National Biodiesel Board. Advanced Biofuel Here and Now Brochure (August 2011). Online at: <http://www.biodiesel.org/docs/default-source/ffs-basics/biodiesel--advanced-biofuel---here-and-now-brochure.pdf?sfvrsn=4>

³⁹² California Energy Commission. Benefits report for the Alternative and Renewable Fuel and Vehicle Technology Program (December 2011). Online at: <http://www.energy.ca.gov/2011publications/CEC-600-2011-008/CEC-600-2011-008-SD.pdf> (page 34)

³⁹³ Ibid (page 37).

³⁹⁴ Ibid (page 37).

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As a result of decreased fuel use and mobile emissions, the implementation of AFV programs generates benefits to public health. With the cleaner technologies of new or retrofitted vehicles, the New York and Illinois programs estimated reductions in pollutants such as particulate matter (PM_{2.5} and PM₁₀), nitrogen oxide (NO_x), hydrocarbons, and carbon monoxide (CO). The Western New York Biodiesel Initiative stated that there was a major reduction in diesel odor and particulate matter emitted from the vehicles.³⁹⁵ Air quality can improve with decreases in these pollutants, potentially improving the health and surrounding environments for school children, mass transit riders, truck drivers, and employees of the companies and jurisdictions participating in these AFV programs. Table 35 shows the reductions to the pollutants quantified for each program.

Table 35. Household Impacts and Co-Benefits of AFV purchase and charging technology and infrastructure support incentives.

New York City Transit Authority Clean-fueled Bus Program	
Effect on Household Consumption and Spending	No data readily available.
Measures to Mitigate to Low-income Populations, or Economic Impact	No data readily available.
Significant Co-benefits	<p>Potential reduction in adverse effects to public health from diesel emissions. Reductions over the lifetime of the vehicles include:</p> <p>PM₁₀ = 89 metric tons</p> <p>NO_x = 1,682 metric tons³⁹⁶</p>
Illinois Green Fleet: Clean Diesel Grant Program	
Effect on Household Consumption and Spending	No data readily available.
Measures to Mitigate to Low-income Populations, or Economic Impact	No data readily available.
Significant Co-benefits	<p>Potential reduction in adverse effects to public health from diesel emissions. Annual reductions include:</p> <p>PM_{2.5} = 5.7 metric tons</p> <p>NO_x = 907 metric tons</p> <p>Hydrocarbons = 8.3 metric tons³⁹⁷</p>

³⁹⁵ NYSERDA Western New York Biodiesel Initiative Case Study. Online at: <http://www.nyserda.ny.gov/Publications/Case-Studies/AFV-Case-Studies.aspx>

³⁹⁶ NYSERDA/New York City Clean-Fueled Bus Program Case Study: Hybrid-electric and Natural Gas Buses. Online at: <http://www.nyserda.ny.gov/Publications/Case-Studies/AFV-Case-Studies.aspx>

³⁹⁷ Illinois Green Fleets: Green Jobs, Clean Diesel, Clean Air. 2009. *A Grant Application submitted to the U.S. Environmental Protection Agency-Region 5 by the Illinois Environmental Protection Agency, the American Lung Association of Illinois, and the Respiratory Health Association of Metropolitan Chicago on behalf of the Illinois Clean Diesel Workgroup*, (page 10). Online at: <http://www.recovery.illinois.gov/documents/Applications/IEPA%2066.039%20National%20Clean%20Diesel.pdf>

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Western New York Biodiesel Initiative	
Effect on Household Consumption and Spending	No data readily available.
Measures to Mitigate to Low-income Populations, or Economic Impact	No data readily available.
Significant Co-benefits	Potential reduction in adverse effects to public health from diesel emissions. There has been a major reduction in diesel odor and particulate matter emitted from the vehicles. ³⁹⁸
USDA Advanced Biofuel Payment Program	
Effect on Household Consumption and Spending	Data not readily available.
Measures to Mitigate to Low-income Populations, or Economic Impact	Data not readily available.
Significant Co-benefits	In addition to job creation and reduced carbon emission, advanced biofuels also create economic development opportunities, reduce urban air pollutants improve public health, and provide long-term energy security.
CEC Alternative and Renewable Fuel and Vehicle Technology Program	
Effect on Household Consumption and Spending	No data readily available.
Measures to Mitigate to Low-income Populations, or Economic Impact	No data readily available.
Significant Co-benefits	In addition to job creation and reduced carbon emission, advanced biofuels also create economic development opportunities, reduce urban air pollutants improving public health, and provide long-term energy security.

³⁹⁸ NYSERDA Western New York Biodiesel Initiative Case Study. Online at: <http://www.nyserdera.ny.gov/Publications/Case-Studies/AFV-Case-Studies.aspx>

13 Investments in Public Transit Infrastructure

Policy Definition	Targeted Sector or Emissions
<p>Public transit includes any means of mass transportation for the general public, which can include buses, trolleys, trains, metro systems, and ferries, among others. Public transit is often provided for reasons other than GHG reduction, including increased mobility of the population and accessibility to transportation, affordability of transportation, and reduced congestion. GHG reduction benefits from public transit come from moving a larger number of people on less fuel, and often cleaner fuel, than traditional passenger motor vehicle travel, reducing fossil fuel consumption, and therefore GHG emissions. In Washington as elsewhere, public transit is primarily a local activity serving the specific needs of each community.</p>	<p>Transportation</p>
GHGs and Costs	
<p>GHG emission reductions directly attributable to public transit infrastructure development are difficult to quantify due to the high number of variables involved. In July of 2010, Johns Hopkins University and the Center for Climate Strategies estimated that transit expansion would result in 27.05 MMTCO₂e annual reduction in GHG emissions nationwide by 2020, at an expected \$16.72/mtCO₂e cost. The analysis of expected reductions considered actions at the federal, state and local levels to implement transit programs, which included additional federal funding, additional state funding and “fast tracking” capital investment, and increased development of transit capacity and maintenance level of effort at the local level.</p> <p>In 2008, the Washington State Climate Advisory Team quantified expected cumulative GHG savings of development and expansion of “Transit, Ridesharing, and Commuter Choice Programs” to be 23.6 MMTCO₂e for the State of Washington from 2008-2020 (cost was not quantified). This policy included reducing statewide per capita VMT and working with local governments and regional planning organizations to achieve state targets.</p>	
Implementation Issues and Lessons Learned	
<ul style="list-style-type: none"> • GHG reductions from expansion of public transit systems are achievable only when riders are taken off of the road at high enough levels to offset the GHG emissions from the operation of the transit system itself. Optimal reductions are achieved when systems are operating at or near ridership capacity. Therefore, it is important to increase ridership on existing infrastructure (which can be done by increasing frequency and reliability of service, among other alternatives) in addition to planning for system expansion. 	
Costs and Benefits to Consumers	Costs and Benefits to Businesses
<ul style="list-style-type: none"> • Funding for state-sponsored public transit improvements would likely come from an increase in taxes (fuel, motor vehicle excise) • Funding from local transit authorities would come from an increase in fares (ferries and transit) or local sales taxes • Benefits include improved mobility and accessibility to transportation to those who can not afford private vehicles or those who prefer to use public transportation in lieu of personal vehicles (providing a reliable and cost-saving alternative), and improved community and environment³⁹⁹ 	<ul style="list-style-type: none"> • Increasing public transit service may reduce the need for businesses to offer parking for employees • Funding for state-sponsored public transit improvements would likely come from an increase in taxes (fuel, motor vehicle excise)

³⁹⁹ Connecting Washington Task Force. January 6, 2012. Page 2.

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- For consumers using public transit, reduced fuel consumption costs transportation expenditures (for example, some households may be able to reduce the total number of cars or save money on maintenance for vehicles used less frequently).

Public transit includes any means of mass transportation for the general public, which can include buses, trolleys, trains, metro systems, and ferries, among others. Ideally, public transit moves a larger number of people on less fuel, and often cleaner fuel, than traditional passenger motor vehicle travel, reducing fossil fuel consumption, and therefore GHG emissions. GHG reductions from expansion of public transit systems are achievable only when riders are taken off of the road at high enough levels to offset the GHG emissions from the operation of the transit system itself. Optimal reductions are achieved when systems are operating at or near ridership capacity. Therefore, it is important to increase ridership on existing infrastructure (which can be done by increasing frequency and reliability of service, among other alternatives) in addition to planning for system expansion.

Public transit infrastructure in Washington State was given a “D+” (poor) grade by the Seattle Section of the American Society of Civil Engineers (ASCE) in their 2013 Report Card for Washington’s Infrastructure, largely due to lack of maintenance, funding, and public transit options not keeping pace with population expansion.⁴⁰⁰ While Washington has made investments in public transit and the State’s grade is higher than the national average for transit, this still indicates an area for improvement that would contribute to emission reductions, with the co-benefit of increased options for mobility and potentially quality-of-life for Washington residents. In 2008, the Washington State Climate Advisory Team quantified expected cumulative GHG savings of development and expansion of “Transit, Ridesharing, and Commuter Choice Programs” to be 23.6 MMTCO₂e for the State of Washington from 2008-2020 (cost was not quantified). This policy included reducing statewide per capita VMT and working with local governments and regional planning organizations to achieve state targets.⁴⁰¹

The ASCE gave the United States a “D” (poor) grade for transit, due to lack of access, funding, and maintenance. ASCE noted that 45 percent of Americans do not have access to public transit, and those that do have access have increased ridership by 9.1 percent in the past ten years, meaning interest in public transit has increased, indicating an area for potential improvement in

⁴⁰⁰ American Society of Civil Engineers (ASCE) Seattle Section. 2013 Report Card for Washington’s Infrastructure. Page 65. Accessed July 2013 at: <http://www.seattleasce.org/reportcard/2013ReportCardWA.pdf>; and ACSE 2013 Report Card for America’s Infrastructure State Facts: Washington. Accessed July 2013 at: <http://www.infrastructurereportcard.org/a/#p/state-facts/washington>

⁴⁰¹ Washington Climate Advisory Team. Leading the Way: A Comprehensive Approach to Reducing Greenhouse Gases in Washington State. January 25, 2008. Table 4.1. Page 76. Accessed September 2013 at: <https://fortress.wa.gov/ecy/publications/publications/0801008b.pdf>

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emission reduction.⁴⁰² Given these factors, successful public transit programs in other countries may serve as the best programs to analyze.

In terms of the policy tools available to the State of Washington for influencing or supporting local transit authorities, the following are activities that WSDOT and the State legislature can undertake:

- WSDOT:
 - Setting state-level goals for transit and communicating and coordinating with transit authorities to ensure implementation of goals (for example, WSDOT's mobility objective of expanding and improving the effectiveness of existing planning and grant programs that support intercity, rural and special needs transportation)⁴⁰³
 - Providing grants and technical assistance to transit authorities
 - Providing planning assistance and direction on the types of projects in which investments should be made
 - Providing a centralized view of the transportation system as a whole (including cross-jurisdictional travel between transit authorities, freeway travel, and other modes of travel)
- State of Washington Legislative authority:
 - Approve "local option" sales tax rate that allows transit authorities to raise revenue
 - Review the classification of public transit as it pertains to the 18th amendment to the Washington State Constitution, potentially allowing gas tax revenues to be used for transit purposes

13.1 Existing Policies

This section analyzes existing policies implemented in other jurisdictions to support public transit infrastructure. California is analyzed because of its comparatively aggressive public transit policies at the state level and its proximity to Washington, and Germany and the United Kingdom are examined because of their successful use of various policies to develop public transit as an economic development tool, their focus on environmental sustainability, and their balance with personal automobile usage.⁴⁰⁴ Vancouver, British Columbia, is included because of its proximity to Washington and similarities to the city of Seattle.

⁴⁰² ACSE 2013 Report Card for America's Infrastructure: Transit. Accessed July 2013 at: <http://www.infrastructurereportcard.org/transit/>

⁴⁰³ Hammond, P. WSDOT Strategic Plan 2011-2017. Strategic Goal: Mobility (Congestion Relief). September 2010. Objective 3.9. Page 26. Accessed September 2013 at: <http://www.wsdot.wa.gov/NR/rdonlyres/533F8188-9F2B-4DAD-BF91-7590086A7904/0/StrategicPlan1117.pdf>

⁴⁰⁴ Akoto, E. *Public Transportation Policies in United States: Drawing Upon Lessons from Germany and United Kingdom*. Global Awareness Society International 21st Annual Conference. New York City, May 2012. Page 2. Accessed

California: The state of California has maintained a Public Transportation Account (PTA) since 1971, of which about half of the funds go to public transit in the State Transit Assistance Program for mass transit operations and capital projects.⁴⁰⁵ Revenue for the PTA comes from State taxes on diesel and gasoline and truck weight fees. California also attracts federal matching funds from the Federal Highway Trust Fund (HTF), which collects funds from Federal fuel excise tax, with 85 percent of funds being allocated by the Federal Highway Administration (FHWA) amongst states as Federal matching funds for state highway system (SHS) projects.⁴⁰⁶

California has a biennially-updated five-year State Transportation Improvement Plan (STIP), which allocates State funds for highway improvements, intercity rail, and regional highway and transit improvements.⁴⁰⁷ In addition, the 2008 Sustainable Communities and Climate Protection Law (SB 375) requires the 18 Metropolitan Planning Organizations (MPOs) in California to establish “sustainable communities strategies” on how to meet GHG reduction targets. As part of their obligations under that law, the cities of San Diego, Sacramento and Southern California regions have formally adopted transportation plans to reduce GHG emissions.⁴⁰⁸

Germany:⁴⁰⁹ In Germany, the public transportation sector market share is five times higher than in the United States, with 8 percent of all German citizens’ trips being made on public transportation, as compared with 1.6 percent of all American citizens’ trips.⁴¹⁰ Germany is smaller and more populated per square mile than the U.S., which suits the country for the development and use of public transit systems. In Germany, the federal government provides a high percentage of the funding for transit systems, and transfers large amounts of money to local governments to fund public transit projects.⁴¹¹ The German federalism reform of 2007 gave full responsibility of public transit systems, including budget management and planning decisions, to state governments.⁴¹²

August 2013 at: <http://orgs.bloomu.edu/gasi/2012%20Proceedings%20PDFs/Eunice%20Akoto-GASI-2012-%20Proceedings%20final-3.pdf>

⁴⁰⁵ California Budget Project. *How is Transportation Funded in California?* (September 2006). Page 3. Accessed July 2013 at: http://www.cbp.org/pdfs/2006/0609_transportationprimer.pdf

⁴⁰⁶ California Department of Transportation. *Transportation Funding in California*. 2011 Page iii-iv. Accessed August 2013 at: http://www.dot.ca.gov/hq/tpp/offices/eab/fundchrt_files/Transportation_Funding_in_California_2011.pdf

⁴⁰⁷ California Transportation Commission. *State Transportation Improvement Program (STIP)*. Accessed July 2013 at: <http://www.catc.ca.gov/programs/stip.htm>

⁴⁰⁸ Gazettenet. *California implements new transportation plans to cut greenhouse gas emissions*. (July 26, 2013). Accessed August 2013 at: <http://www.gazettenet.com/home/7745999-95/california-implements-new-transportation-plans-to-cut-greenhouse-gas-emissions>

⁴⁰⁹ Buehler, R. and J. Pucher. *Demand for Public Transport in Germany and the USA: An Analysis of Rider Characteristics*. *Transport Review*. Vol. 32, No. 5, 541–567. (September 2012) Accessed July 2013 at: http://policy.rutgers.edu/faculty/pucher/PublicTransport_TRV_2012_BuehlerPucher_FINAL.pdf

⁴¹⁰ Buehler, R. and J. Pucher. *Making Public Transport Financially Sustainable*. *Transport Policy*, Volume 18, in press. Page 4. Accessed July 2013 at: <http://policy.rutgers.edu/faculty/pucher/Sustainable.pdf>

⁴¹¹ Victoria Transport Policy Institute and Stantec Consulting Ltd. *National Strategies on Public Transit Policy Framework – Final Report*. May 2011. Page iv. Accessed August 2013 at: <http://www.cutaactu.ca/en/publicaffairs/resources/FianlReport-G8.pdf>

⁴¹² Victoria Transport Policy Institute and Stantec Consulting Ltd. May 2011. Page 72.

United Kingdom:⁴¹³ The U.K. public transit system is among the best in Europe, and, the U.K.'s small but populous geography lends itself well to the development and use of public transit systems, specifically in systems with the potential to maximize ridership and reduce GHGs. The U.K. passed Transport Acts in 1980⁴¹⁴ and 1985⁴¹⁵ which limited regulation of the transit industry, and provided opportunities for private transit expansion by providing opportunities for privatization and limiting regulations on the transit industry.⁴¹⁶ In the U.K., 68 percent of transit system funding is obtained through commercial revenues, while 32 percent is from government subsidies.⁴¹⁷

As part of the UK's Climate Change Act of 2008, and the associated Carbon Plan released in December of 2011, the government is funding specific public transit infrastructure improvement projects, including setting up the Local Sustainable Transport Fund to fund local-level transit projects aimed at economic growth and GHG reduction, the electrification of the North Transpennine route from Manchester to York (a rail transit project), and funding the fourth installment of the Green Bus fund, which supports the purchase of low carbon emission buses.⁴¹⁸

Vancouver, British Columbia: TransLink is metropolitan Vancouver's central transit authority, which provides planning and services for transit, roadways, and walking. Since 2006, TransLink has operated with a stated Emissions Policy, which notes its commitment to reducing regional GHGs through decreased car ridership, using a variety of broad policies, along with its commitment to reduce its own organizational GHG emissions from the transit fleet.

TransLink has a 10-Year Transportation and Financial Plan, which involves the first integrated public transportation system in North America to be responsible for planning, financing, and managing the transit system along with major roads, bridges and modes of transportation.⁴¹⁹ The Plan involves three fully-funded years and an additional seven-year outlook. The Plan notes an expected revenue shortfall of \$472 million from 2015 to 2015, due to increased prices of fuel, lack of new revenue sources, a declined request to the transportation commissioner to increase fares and lower toll revenues than forecast.⁴²⁰ This will be partially offset by \$98 million per year

⁴¹³ United Kingdom Department for Transport. Accessed July 2013 at:

<https://www.gov.uk/government/organisations/department-for-transport>

⁴¹⁴ United Kingdom Legislation. Transport Act of 1980. Accessed July 2013 at:

<http://www.legislation.gov.uk/ukpga/1980/34/contents>

⁴¹⁵ United Kingdom Legislation. Transport Act of 1985. Accessed July 2013 at:

<http://www.legislation.gov.uk/ukpga/1985/67/contents>

⁴¹⁶ Akoto, E. (May 2012). Page 9. Accessed August 2013.

⁴¹⁷ Akoto, E. (May 2012). Page 11. Accessed August 2013.

⁴¹⁸ United Kingdom Department for Transport. *Reducing greenhouse gases and other emissions from transport*. October 3, 2012. Accessed August 2013 at: <https://www.gov.uk/government/policies/reducing-greenhouse-gases-and-other-emissions-from-transport>

⁴¹⁹ TransLink. The 10-Year Transportation and Financial Plan. Accessed September 2013 at:

<http://www.translink.ca/en/Plans-and-Projects/10-Year-Plan.aspx>

⁴²⁰ TransLink. 2013 Base Plan and Outlook. Financial Challenge. Accessed September 2013 at:

<http://www.translink.ca/en/Plans-and-Projects/10-Year-Plan/Base-Plan-and-Outlook.aspx>

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in cost savings measures (reducing overtime and administrative costs) and revenue increasing (service optimization, reduced fare evasion and increased ridership with no new service).⁴²¹

Annual trips per capita in Vancouver were 56 bus, 33 light rail, and 1 commuter rail in 2010, compared with Seattle's 43 bus, 3 light rail and 1 commuter rail trips in 2010.⁴²² In Vancouver, 61.4 percent of metropolitan residents and jobs are within walking distance from public transit, as compared with Seattle's 35.2 percent.⁴²³

13.2 GHG Impacts

GHG emission reductions directly attributable to public transit infrastructure development are difficult to quantify due to the high number of variables involved. GHG reductions come primarily from passenger vehicle riders changing modes of transportation to take more trips on public transit systems, increasing the efficiency of the public transit systems by increasing ridership on existing infrastructure, and from increasing the efficiency of public transit systems by electrification or cleaner running technologies, such as low emission bus fleets.

Table 36 below, summarizes the available GHG-related information for California, Germany and United Kingdom public transit infrastructure programs.

Table 36: GHG Costs and Benefits of Example Public Transit Infrastructure Programs

California	
Cost of Reductions	The 2014 STIP estimates that California will spend the following amounts for the 2013 – 2014 year: ⁴²⁴ <ul style="list-style-type: none">• \$28.5 million on Rail and Mass Transportation support• \$125.7 million on Intercity Rail support• \$32 million capital outlay for STIP Rail and Mass Transportation projects• \$3 million on the Bay Area Ferry
Volume of Reductions	None noted.
Programmatic Status	The state-level policies for public transit development in California are among the most aggressive in the United States.
Emissions Leakage	None noted.
Germany	

⁴²¹ TransLink. 2013 Base Plan and Outlook. Efficiencies. Accessed September 2013 at:

<http://www.translink.ca/en/Plans-and-Projects/10-Year-Plan/Base-Plan-and-Outlook.aspx>

⁴²² Williams-Derry, C. Transit Smackdown: Seattle vs. Portland vs. Vancouver. Sightline Daily. July 18, 2012. Accessed September 2013 at: <http://daily.sightline.org/2012/07/18/transit-smackdown-seattle-vs-portland-vs-vancouver/> Note that these did not include ferry trips in the total trip count, which are significant for the city of Seattle.

⁴²³ Scheurer, J. Spatial Network Analysis in Vancouver: Are we a Best-Practice Model for Land Use-Transport Integration? July 2, 2013. (PowerPoint Presentation) Slide 12. Accessed September 2013 at:

<http://www.sfu.ca/content/dam/sfu/continuing-studies/forms-docs/city/vancouver-salon-presentation-020713.pdf>

⁴²⁴ California Transportation Commission. *DRAFT 2014 STIP Fund Estimate*. June 11, 2013. Page 3. Accessed August 2013 at: http://www.catc.ca.gov/programs/STIP/2014_STIP/2014_draft_FundEstimates.pdf

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Cost of Reductions	<p>Through the Entflechtungsgesetz program, Germany provides around €1.6 billion (about US\$2.1 billion) every year to capital investment projects for urban transportation.⁴²⁵ Of note, Federal funds do not go to the railway operators (Deutsche Bahn) as the railways are expected to be economically viable without government assistance once operational.⁴²⁶</p> <p>Through the RegG program, Germany provides funds for public transit operation. In 2008, this amounted to €6.7 billion (about US\$8.8 billion).</p> <p>State governments in Germany also contribute to funding, though this accounts for less than 10 percent of the total government contributions. In 2008, State government contributions were €907.2 million (about US\$1.2 billion)⁴²⁷</p>
Volume of Reductions	None noted.
Programmatic Status	<p>The successes of the German program are attributed to:⁴²⁸</p> <ul style="list-style-type: none"> • Expanded and improved service • Attractive Fares • Regional and Intermodal Coordination • Car Restrictions • Land-use Policies
Emissions Leakage	None noted.
United Kingdom	
Cost of Reductions	<p>The UK's Climate Change Act of 2008 and associated Carbon Plan, as released in December 2011 include the following transit funding actions:⁴²⁹</p> <ul style="list-style-type: none"> • £600 million (about US\$930 million) from the Local Sustainable Transport Fund between 2011 and 2015 for 96 local transport projects across England to promote economic growth and cut carbon emissions. • Providing a further £20 million (about US\$30 million) for the purchase of low carbon emission buses through the fourth round of the Green Bus fund, bringing the total support for this initiative to £95 million (about US\$145 million) since its launch.
Volume of Reductions	<p>The Carbon Plan released In December 2011 includes public transit as part of transport emissions reduction policies. By 2027, transport emissions should be between 17 and 28 percent lower than 2009 levels, according to the Plan. However, the majority of the decrease is expected to come from increases in personal vehicle efficiencies, not public transit investments.⁴³⁰ This is estimated to be a decrease of about 21 MMTCO_{2e}.⁴³¹</p>

⁴²⁵ Victoria Transport Policy Institute and Stantec Consulting Ltd. May 2011. Page 72.

⁴²⁶ Victoria Transport Policy Institute and Stantec Consulting Ltd. May 2011. Page 73.

⁴²⁷ Victoria Transport Policy Institute and Stantec Consulting Ltd. May 2011. Page 74.

⁴²⁸ Jaffe, E. *5 Reasons Germans Ride 5 Times More Mass Transit Than Americans*. The Atlantic. (October 5, 2012).

Accessed July 2013 at: <http://www.theatlanticcities.com/commute/2012/10/5-reasons-germans-ride-5-times-more-transit-americans/3510/>

⁴²⁹ United Kingdom Department for Transport. *Reducing greenhouse gases and other emissions from transport*. October 3, 2012. Accessed August 2013 at: <https://www.gov.uk/government/policies/reducing-greenhouse-gases-and-other-emissions-from-transport>

⁴³⁰ United Kingdom Department for Transport. *The Carbon Plan: Delivering our Low Carbon Future*. December 2011. Page 8. Accessed August 2013 at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/47614/3751-carbon-plan-executive-summary-dec-2011.pdf

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Programmatic Status	The UK's public transit system is considered among the best in Europe. The success of the Climate Change Act of 2008 and associated Carbon Plan will be better understood as the program evolves.
Emissions Leakage	None noted.
Vancouver, BC (TransLink)	
Cost of Reductions	Translink has seen its cost per revenue passenger decline from \$3.85 in 2008 to \$3.76 in 2012. Total expenditures in 2012 were \$1.43 billion, broken down as follows: ⁴³² <ul style="list-style-type: none"> • 60 percent Transit Operations • 13 percent Interest Expense • 12 percent Amoritization of Capital Assets • 8 percent Roads and Bridges • 4 percent Administration • 2 percent Transit Police • 1 percent AirCare
Volume of Reductions	In 2011, TransLink achieved Gold Level Status under APTA's Sustainability commitment for GHG progress (making TransLink the first transportation authority in North America to achieve this status). ⁴³³ Vancouver's AirCare Program, a mandatory vehicle emissions testing program operated by TransLink's wholly-owned subsidiary Pacific Vehicle Testing Technologies, Ltd., has reduced vehicle emissions by 33 percent since 1992. ⁴³⁴
Programmatic Status	As noted in a study by the Victoria Transport Policy Institute, Vancouver has seen a decline in the number of registered automobiles and a reduction in downtown automobile trips, which has been attributed to increased transit services. ⁴³⁵
Emissions Leakage	None noted.

13.3 Energy and Economic Impacts

The specific energy and economic impacts of focus for this analysis are not discussed in detail in analysis documents for the programs reviewed, as there are too many interacting variables and no specific data. As such, Table 37, below, summarizes the conceptual energy and economic impacts of implementing public transit infrastructure programs.

⁴³¹ United Kingdom Department for Transport. *The Carbon Plan: Delivering our Low Carbon Future*. December 2011. Page 47. Accessed August 2013 at:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/47615/3752-carbon-plan-parts-13-dec-2011.pdf

⁴³² TransLink 2012 Annual Report Highlights. Accessed September 2013 at: <http://www.translink.ca/en/About-Us/Corporate-Overview/Corporate-Reports/Annual-Report.aspx>

⁴³³ TransLink 2012 Annual Report. Page 51. Accessed September 2013 at: http://www.translink.ca/~media/documents/about_translink/corporate_overview/annual_reports/2012/translink_2012_annual_report.ashx

⁴³⁴ TransLink 2012 Annual Report. Page 31. Accessed September 2013 at: http://www.translink.ca/~media/documents/about_translink/corporate_overview/annual_reports/2012/translink_2012_annual_report.ashx

⁴³⁵ Page 16. Accessed September 2013 at: <http://www.vtpi.org/tranben.pdf>

Table 37: Energy and Economic Impacts of Example Public Transit Infrastructure Programs

Conceptual Analysis	
Independence from Fossil Fuels, and Economic Impact	Depending on the type of transit system that is implemented and the adoption of travelers who were formally using personal vehicles, public transit can increase independence from fossil fuels. For example, large-scale implementation of electric rail transit in a state like Washington, where a large portion of the electricity is generated from hydro power, can aid in reducing the amount of fossil fuel consumed from personal vehicle trips.
Impacts on Fuel Choice	The availability of public transit does not affect the consumer fuel choice of travelers using personal vehicles. However, the fuel used for public transit may be different than the fuel used for personal vehicles (for example, lower emissions fuels such as CNG or biodiesel may be used in public transit buses, while gasoline or diesel may be used in personal vehicles).
Opportunity for Investments in Infrastructure and Clean Energy/Energy Efficiency	Public transit systems are infrastructure-intensive. Transit-related investments can be made in clean energy and energy efficient technologies; for example, low emitting buses and electric rail systems. The American Public Transportation Association (APTA) estimates that every dollar invested in public transportation results in four dollars of economic returns to the community. ⁴³⁶
Impact on Different Sectors of the Economy	Construction and transportation sectors will be directly benefitted from investments in public transit.

13.4 Household Impacts and Co-Benefits

The specific household impacts of focus for this analysis are not discussed in detail in analysis documents for the programs reviewed. Generally, investments in public transit improve personal wellbeing, with increased access to mobility and transportation, and can enhance a jurisdiction's economy through additional job opportunities.⁴³⁷ Table 38 below, summarizes the available information on impacts and co-benefits for implementing public transit infrastructure programs.

Table 38: Household Impacts and Co-Benefits of Example Public Transit Infrastructure Programs

California	
Effect on Household Consumption and Spending	None noted.

⁴³⁶ American Public Transportation Association. Public Transportation Benefits. Accessed August 2013 at: <http://www.apta.com/mediacenter/ptbenefits/Pages/default.aspx>

⁴³⁷ American Public Transportation Association. Public Transportation Benefits. Accessed August 2013 at: <http://www.apta.com/mediacenter/ptbenefits/Pages/default.aspx>

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Measures to Mitigate to Low-income Populations, or Economic Impact	<p>The State of California's Department of General Services offers transit vouchers to State employees who use public transportation to and from work, covering up to 75 percent of the cost per month (to a maximum of \$65 per month).⁴³⁸</p> <p>Vouchers are provided by local and regional transit authorities (for example, Inglewood has a taxi voucher for customers 60 years or older with demonstrated need, or 18 years or older with a proof of disability).⁴³⁹</p>
Significant Co-benefits	<p>Reduced congestion from fewer personal vehicles, access to travel options for passengers who do not otherwise have access to personal vehicles. Benefits also include improved mobility and accessibility to transportation to those who cannot afford private vehicles or those who prefer to use public transportation in lieu of personal vehicles (providing a reliable and cost-saving alternative), and improved community and environment. For consumers using public transit, reduced fuel consumption costs transportation expenditures (for example, some households may be able to reduce the total number of cars or save money on maintenance for vehicles used less frequently).</p>
Germany	
Effect on Household Consumption and Spending	None noted.
Measures to Mitigate to Low-income Populations, or Economic Impact	<p>There are two types of subsidies that are provided nationally to German transit users:⁴⁴⁰</p> <ul style="list-style-type: none"> • The SuperGold Card: provides seniors aged 65 years and older and veterans free • rides on transit during non-peak hours • Discounted taxi services are available for people with disabilities. Taxi vouchers provide a 50 percent discount off normal taxi fares
Significant Co-benefits	<p>Reduced congestion from fewer personal vehicles, access to travel options for passengers who do not otherwise have access to personal vehicles. Benefits also include improved mobility and accessibility to transportation to those who can not afford private vehicles or those who prefer to use public transportation in lieu of personal vehicles (providing a reliable and cost-saving alternative), and improved community and environment. For consumers using public transit, reduced fuel consumption costs transportation expenditures (for example, some households may be able to reduce the total number of cars or save money on maintenance for vehicles used less frequently).</p>
United Kingdom	
Effect on Household Consumption and Spending	None noted.
Measures to Mitigate to Low-income Populations, or Economic Impact	No national-level public transit voucher system was noted in the United Kingdom.

⁴³⁸ California Department of General Services. Transit Vouchers. Accessed August 2013 at:

<http://www.dgs.ca.gov/ofam/Programs/Parking/TransitVouchers.aspx>

⁴³⁹ http://www.cityofinglewood.org/depts/rec/human_services/transportation/taxi_coupon_vouchers.asp

⁴⁴⁰ Victoria Transport Policy Institute and Stantec Consulting Ltd. May 2011. Page 34.

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Significant Co-benefits	Reduced congestion from fewer personal vehicles, access to travel options for passengers who do not otherwise have access to personal vehicles. Benefits also include improved mobility and accessibility to transportation to those who can not afford private vehicles or those who prefer to use public transportation in lieu of personal vehicles (providing a reliable and cost-saving alternative), and improved community and environment. For consumers using public transit, reduced fuel consumption costs transportation expenditures (for example, some households may be able to reduce the total number of cars or save money on maintenance for vehicles used less frequently).
Vancouver, BC (TransLink)	
Effect on Household Consumption and Spending	None noted.
Measures to Mitigate to Low-income Populations, or Economic Impact	In July of 2013, it was announced that TransLink's "FareSavers" program for low-income customers would be phased out as early as January 2014. ⁴⁴¹ The "Compass" program will be introduced, which will allow for discounts over standard cash fees. TransLink notes that details will be forthcoming on additional programs to aid low-income customers.
Significant Co-benefits	Reduced congestion from fewer personal vehicles, access to travel options for passengers who do not otherwise have access to personal vehicles. Benefits also include improved mobility and accessibility to transportation to those who cannot afford private vehicles or those who prefer to use public transportation in lieu of personal vehicles (providing a reliable and cost-saving alternative), and improved community and environment. For consumers using public transit, reduced fuel consumption costs transportation expenditures (for example, some households may be able to reduce the total number of cars or save money on maintenance for vehicles used less frequently). Vancouver region traffic crash data have shown that automobile crash rates decline significantly with: bus stop density, percentage of transit-km traveled relative to total vehicle-kms traveled, and walking, biking, and transit commute mode share. ⁴⁴²

⁴⁴¹ TransLink. Tariff Changes – July 2013. Accessed September 2013 at: <http://www.translink.ca/en/About-Us/Governance-and-Board/Bylaws/Tariff-Changes.aspx>

⁴⁴² Page 45 Accessed September 2013 at: <http://www.vtpi.org/tranben.pdf>

14 Public Benefit Fund

Policy Definition	Targeted Sector or Emissions
A funding mechanism often used to support programs related to energy efficiency, renewable energy, clean energy research and development, low-income assistance, and other programs that benefit the public at large. Funds are typically collected from electricity and natural gas ratepayers through a system benefits charge on their monthly utility bills.	Electricity and natural gas consumption in RCI sector
GHGs and Costs	
<ul style="list-style-type: none"> • GHG reductions and reduction costs vary widely depending on the portfolio of PBF-funded programs. • GHG reduction costs range from \$29/mtCO₂ to \$99/mtCO₂ for jurisdictions analyzed in this study. • Cumulative lifetime GHG reductions from PBF-fund programs are typically in the tens of millions of metric tons CO₂ • System benefit charges range from about \$0.0002/kWh to \$0.0085/kWh depending on the state. 	
Implementation Issues and Lessons Learned	
<ul style="list-style-type: none"> • Utility companies with coupled profits and sales may be opposed to a PBF because the energy efficiency and renewable energy programs funded by a PBF may reduce sales, revenue, and profit. • Large energy consumers may oppose a PBF policy due to concerns about added energy costs. 	
Costs and Benefits to Consumers	Costs and Benefits to Businesses
<ul style="list-style-type: none"> • Electricity rates will increase on a per kilowatt-hour basis as a result of the SBC, thus, higher energy consumers will pay more on an annual basis. These increased costs may be offset by the availability of resources for energy efficiency improvements. • Increased access to energy conservation and distributed renewable technology incentives and financing. 	<ul style="list-style-type: none"> • Electricity rates will increase on a per kilowatt-hour basis as a result of the SBC, thus, energy intensive businesses such as is common in the industrial sector will pay more on an annual basis. These increased costs may be offset by the availability of resources for energy efficiency improvements. • Increased access to energy conservation and distributed renewable technology incentives and financing and R&D funding. • Expanded clean energy talent pool and job creation.

A public benefits fund (PBF) is a policy mechanism intended to provide long-term, stable funding to support a variety energy-related programs that benefit the public at large. Specifically, states use PBFs to fund programs related to energy efficiency, investment in renewable energy, reduction of energy usage, environmental concerns, and aid to low-income customers.⁴⁴³

Through the successful reduction of energy usage, PBFs not only reduce GHG emissions but can save customers millions of dollars in energy costs through financial (for example, rebates, grants, loans and performance-based incentives) and technical efficiency assistance, training programs, education, and investment in renewable energy sources.

PBF revenues are typically collected from ratepayers through a small surcharge (a “system benefits charge”) on electricity and/or gas consumption, or through a flat monthly fee. These

⁴⁴³ DSIRE. 2013. Public Benefit Funds. Accessed August 2013 at: <http://www.dsireusa.org/solar/solarpolicyguide/?id=22>

charges are typically “non-bypassible,” meaning they are assessed to all customers in a nondiscriminatory fashion since customers are charged a PBF fee without regard to where they purchase electricity (the charge is assessed for use of the distribution system rather than based upon the source of the electricity).⁴⁴⁴ Alternatively, some PBFs are funded through specified contributions from utilities.⁴⁴⁵ Recently, some states have begun to supplement PBFs using alternative compliance payments made by utilities under state renewable portfolio standard (RPS) programs, or the revenue from the sale of carbon emissions allowances in the Regional Greenhouse Gas Initiative (RGGI) auctions.⁴⁴⁶

PBF administration strategies vary by state. State energy offices, state agencies, state public service commissions, quasi-state organizations, nonprofit organizations, and utilities have been tasked in different states to be PBF administrators. A majority of PBF states utilize a hybrid approach, where different entities are responsible for managing separate aspects of the PBF under the direction of one primary oversight body.⁴⁴⁷

As part of a 2006 Ballot Initiative (Initiative 937), utilities in Washington are allowed to recover costs of their RPS mandates through PBF-like charges to customers, though Initiative 937 set up no state-level PBF for use in incentivizing renewable energy or energy efficiency projects.⁴⁴⁸

14.1 Existing Policies

Currently, 30 states and Washington, D.C. have a PBF fund of some sort.⁴⁴⁹ The following are some examples of mandatory programs with rigorous state-level oversight and significant funding levels:

California: California created a PBF in 1998 to fund renewable energy, energy efficiency, and research, development and demonstration (RD&D) projects. Originally, the PBF collected a public goods charge (PGC) only on ratepayer electricity use, but a gas surcharge was added in 2001. The California Public Utilities Commission (CPUC) separately collects funds for the California Solar Initiative (CSI), the Self-Generation Incentive Program, the Renewables Portfolio Standard and others programs, but they are not captured in this analysis. In 2011, the state failed to pass legislation authorizing PGC collections in 2012 or later years. However, the Electric Program Investment Charge (EPIC) fund was created to collect funds to continue support for renewable energy and RD&D projects. In addition, a portion of the Procurement

⁴⁴⁴ DOE. 2010. Public Benefit Funds: Increasing Renewable Energy & Industrial Energy Efficiency Opportunities. Accessed August 2013 at: <http://www1.eere.energy.gov/manufacturing/states/pdfs/publicbenefitfunds.pdf>

⁴⁴⁵ Center for Climate and Energy Solutions, 2013. Public Benefit Funds. Accessed August 2013 at: <http://www.c2es.org/sites/default/modules/usmap/pdf.php?file=5893>

⁴⁴⁶ DSIRE. 2013. Public Benefit Funds. Accessed August 2013 at: <http://www.dsireusa.org/solar/solarpolicyguide/?id=22>

⁴⁴⁷ DOE. 2010. Public Benefit Funds: Increasing Renewable Energy & Industrial Energy Efficiency Opportunities. Accessed August 2013 at: <http://www1.eere.energy.gov/manufacturing/states/pdfs/publicbenefitfunds.pdf>

⁴⁴⁸ Ibid

⁴⁴⁹ Ibid

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Energy Efficiency Balancing Account (PEEBA) was used to continue support for EE and low-income assistance programs on an interim basis. Further CPUC action is needed to continue funding of these programs.⁴⁵⁰

The California PGC/EPIC surcharge is non-bypassable, and the CPUC oversees the fund. Generally, the California Energy Commission (CEC) administers the renewable energy and RD&D programs, while utilities administer the energy efficiency and low-income assistance programs. California's surcharges on ratepayer electricity use average \$0.0054/kWh for energy efficiency, \$0.0016/kWh for renewable energy, and \$0.0015/kWh for RD&D. From inception through about 2011, the PGC fund distributed approximately \$228 and \$62.5 million annually for energy efficiency and RD&D, respectively. Renewables received \$135 million annually from 2002 to 2007 and \$65.5 million annually from 2008 to 2011. Beginning 2005, natural gas subaccount baseline funding was \$12 million with increases of up to \$3 million annually to a \$24 million cap. According to EPIC investment planning documents, \$368.8 million has been budgeted for applied research and development, technology demonstration and deployment, and market facilitation from 2012 to 2014.⁴⁵¹

Connecticut: Connecticut created separate PBFs to support energy efficiency and renewable energy in 1998. The state's two investor-owned utilities (IOU) began collecting electricity surcharges for the Energy Efficiency Fund and the Clean Energy Fund in 2000 for energy efficiency and renewable energy, respectively. Separately, each municipal electric utility is required to establish a fund for renewable energy, energy efficiency, conservation and load-management programs.⁴⁵²

Connecticut Energy Efficiency Fund (CEEF): The CEEF is funded by a surcharge of \$0.003/kWh on Connecticut Light and Power and United Illuminating customers' electric bills. Each of the two utilities administers and implements efficiency programs with approval from the Connecticut Department of Public Utility Control. The CEEF also receives funding from the Regional Greenhouse Gas Initiative (RGGI), the ISO New England Forward Capacity Market (FCM), and Class III Renewable Credits. In 2011, the fund collected \$154 million (\$130.3 million from ratepayer collections; \$3.6 million from ARRA/Oil; \$17.9 million from the Forward Capacity Market; \$5.6 million from Class III Renewables; \$5.8 million from RGGI).⁴⁵³

Connecticut Clean Energy Fund (CCEF): The CCEF is administered by the Clean Energy Finance and Investment Authority (CEFIA), a quasi-governmental investment organization. In 2000-2001 the IOU ratepayer charge was set at \$0.0005/kWh, rising to \$0.00075/kWh in 2002-

⁴⁵⁰ DSIRE. 2013. California Public Benefits Funds for Renewables and Efficiency. Accessed August 2013 at:

http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=CA05R

⁴⁵¹ DSIRE. 2013. California Incentives/Policies for Renewables & Efficiency: Public Benefits Funds for Renewables and Efficiency. Accessed August 2013 at: http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=CA05R

⁴⁵² DSIRE. 2013. Connecticut Energy Fund. Accessed August 2013 at:

http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=CT12R

⁴⁵³ Ibid

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2003 and "not less than" \$0.001/kWh beginning July 1, 2004. Between 2000 and 2010, the CCEF distributed about \$151 million or approximately \$20 million annually (in 2010 \$4.67 million came from ARRA). Funding from the CCEF is expected to be about \$29 million annually from 2011 to 2017. Technologies eligible for funding include solar PV, biomass, hydroelectric, fuel cells, CHP/cogeneration, hydrogen, tidal energy, wave energy, ocean thermal, ethanol, biodiesel, fuel cells using renewable fuels, and other distributed generation technologies.⁴⁵⁴

New Jersey: New Jersey created a Societal Benefits Charge (SBC) to support six programs benefitting residents, businesses and municipalities beginning in 2001.⁴⁵⁵

- New Jersey's Clean Energy Program (NJCEP)
- Social Programs
- Nuclear Decommissioning Trust Fund
- Universal Service Fund
- Remediation Adjustment Clause (RAC) Expenditures
- Consumer Education

This analysis focuses on the NJCEP, a statewide initiative administered by the New Jersey Board of Public Utilities (BPU) that promotes increased energy efficiency and the use of clean, renewable sources of energy (the other SBC-funded programs have limited or no impact on energy and emissions). In 2012, the NJCEP received about 40 percent of total SBC fund distributions. Management of the NJCEP was turned over to third-party program managers Honeywell Utility Solutions and TRC Energy Solutions in 2007 with continued oversight by the BPU.⁴⁵⁶

The SBC is non-bypassable and assessed to all customers of New Jersey's seven investor-owned electric and gas public utilities. The amount collected is determined by the BPU and is currently set to about 3.8 percent of ratepayer energy bills. A total of \$482 million was collected during 2001-2004 and a total of \$745 million was collected from 2005-2008. In September 2008, the BPU approved a 2009-2012 budget of \$1.213 billion, with approximately 80 percent (\$950 million) of the budget devoted to energy efficiency programs and 20 percent (\$243 million) allocated for renewable energy programs. Any unused funds from previous years are carried into the next year's budget. In November 2012, the BPU approved a six-month extension of funding through June 2013, and is currently considering funding levels for Fiscal Years (FY) 2014-2017. It is important to note that these budget numbers do not account for a variety of factors that may

⁴⁵⁴ DSIRE. 2013. Connecticut Clean Energy Fund. Accessed August 2013 at:

http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=CT03R&re=1&ee=1

⁴⁵⁵ NJ Clean Energy Program. 2013. About NJCEP: Societal Benefits Charge. Accessed August 2013 at:

<http://www.njcleanenergy.com/main/about-njcep/societal-benefits-charge/societal-benefits-charge-sbc>

⁴⁵⁶ DSIRE. 2013. New Jersey Societal Benefits Charge. Accessed August 2013 at:

http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=NJ04R

have small or large impacts on the actual annual budget including interest earned on the balance of funds that have already been collected, budget re-allocations between the energy efficiency and renewable energy, supplemental alternative compliance payments (ACPs) made under the state RPS, and transfers of money out of the fund to serve other state purposes.⁴⁵⁷

Oregon: Oregon's electricity IOUs began collecting a three percent public purpose charge (PPC) from their customers to support renewable energy and energy efficiency projects in 2002. In addition, Oregon natural gas customers are assessed a charge of 1.25-1.5 percent depending on their provider. The Energy Trust of Oregon (Energy Trust), an independent non-profit organization overseen by the Oregon Public Utilities Commission, receives about 74 percent of PPC funds. School districts receive about 10 percent of PPC funds for energy efficiency improvements in individual schools. The remaining 16 percent of PPC funds are dedicated to low-income housing development and weatherization assistance programs.⁴⁵⁸ This analysis focuses on Energy Trust activities due to data availability.

Energy Trust funding from the PPC was about \$83 million in 2012 with an additional \$63 million coming from other sources. The Energy Trust's renewable energy programs include financial incentives for projects less than 20 megawatts (MW) that generate energy from solar, wind, hydro, biomass and geothermal resources. Efficiency programs include incentives for improvements to residential, commercial and new buildings, retrofit, appliances and manufacturing processes. The Energy Trust accepts applications for funding in response to specific programs, as well as through an open solicitation process. At least 80 percent of the energy conservation expenditures are concentrated in the service territory of the utility where the funds were collected. In 2007, Oregon's RPS legislation extended the program until 2025.⁴⁵⁹

14.2 GHG Impacts

Public benefit funds contribute to GHG reductions by funding energy efficiency and renewable energy programs that reduce energy consumption and replace traditional fossil fuel power generation with renewable sources. Each state administers a unique portfolio of funded programs and tracks slightly different metrics, making these programs difficult to compare to one another. In general, GHG impacts were only estimated for energy efficiency programs. New Jersey maintains an aggressive program with cumulative lifetime GHG reductions of 60.9 MMTCO₂e at a cost of about \$29 per mtCO₂e for projects implemented from 2001 to 2012.⁴⁶⁰ By contrast, the Energy Trust of Oregon has achieved 8.4 MMTCO₂e of cumulative lifetime reductions at a cost

⁴⁵⁷ Ibid

⁴⁵⁸ DSIRE. 2013. Energy Trust of Oregon. Accessed August 2013 at: http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=OR05R&re=1&ee=1

⁴⁵⁹ Ibid

⁴⁶⁰ NJ Clean Energy Program. 2013. NJCEP Cumulative Results 2000-2012. Accessed August 2013 at: <http://www.njcleanenergy.com/files/file/2001-2012%20Program%20Results.xls>

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of about \$99 per mtCO₂e.⁴⁶¹ California spends significantly more each year on energy efficiency, renewable energy, and research projects than any other state. California's energy efficiency activities during 2010 and 2011 have reduced state emissions by 3.4 MMTCO₂e per year.⁴⁶² Table 39 summarizes the available GHG-related information for the California, Connecticut, New Jersey, and Oregon programs.

Table 39: GHG Costs and Benefits of Example Energy Programs Funded by Public Benefit Funds

California Energy Efficiency Program (funded by Public Goods Charge)⁴⁶³	
Cost of Reductions	Cumulative lifetime emissions savings not presented. \$1.6 billion spent from 2010-2011 for EE programs (\$1,460 million for programs that directly reduce emissions).
Volume of Reductions	3.4 MMTCO₂e per year from 2010-2011 energy efficiency activities.
Programmatic Status	Yes. The program is cost-effective overall, met savings goals, and made progress in all market sectors to encourage long-term market transformation. The program has achieved a total resource cost (TRC) test benefit to cost ratio of 2.02.
Emissions Leakage	None noted.
California Renewable Energy Program (funded by Public Goods Charge)⁴⁶⁴	
Cost of Reductions	Cumulative lifetime emissions savings not presented. \$934 million spent from 1998-2011 for renewable energy programs.
Volume of Reductions	GHG reductions were not estimated.
Programmatic Status	Overall, the program has been considered a success. However, results for individual programs have been mixed.
Emissions Leakage	None noted.
California RD&D Program (funded by Public Goods Charge)⁴⁶⁵	
Cost of Reductions	Cumulative lifetime emissions savings not presented. \$840 million spent for RD&D projects from 1997-2012
Volume of Reductions	GHG reductions were not estimated.

⁴⁶¹ Energy Trust of Oregon. 2013. 2012 Annual Report to the Oregon Public Utility Commission. Accessed August 2013 at:

http://energytrust.org/library/reports/2012_ETO_Annual_Report_OPUC1.PDF

⁴⁶² California Public Utilities Commission. 2012. 2010 – 2011 Energy Efficiency Annual Progress Evaluation Report. Accessed August 2013 at:

<http://www.cpuc.ca.gov/NR/rdonlyres/89718A1B-C3D5-4E30-9A82-74ED155D0485/0/EnergyEfficiencyEvaluationReport.pdf>

⁴⁶³ Ibid

⁴⁶⁴ California Energy Commission. 2011. Renewable Energy Program 2011 Annual Report To The Legislature. Accessed August 2013 at:

<http://www.energy.ca.gov/2011publications/CEC-300-2011-007/CEC-300-2011-007-CMF.pdf>

⁴⁶⁵ California Energy Commission. 2013. Public Interest Energy Research 2012 Annual Report. Accessed August 2013 at: <http://www.energy.ca.gov/2013publications/CEC-500-2013-013/CEC-500-2013-013-CMF.pdf>

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Programmatic Status	Yes. The program is credited with significant job creation and inducing private investment.
Emissions Leakage	None noted.
Connecticut Energy Efficiency Fund⁴⁶⁶	
Cost of Reductions	\$69/mtCO ₂ e (cumulative lifetime reductions from 2012 activities).
Volume of Reductions	2012 energy efficiency activities are expected to generate 182,000 mtCO₂/yr, and 2.1M mtCO₂e cumulatively over their lifetime.
Programmatic Status	Yes. The program is credited with reduced customer costs, job creation, and making the state's businesses more competitive. Connecticut also climbed to 6th in ACEEE 2012 State Energy Efficiency Scorecard Ranking.
Emissions Leakage	None noted.
Connecticut Clean Energy Fund⁴⁶⁷	
Cost of Reductions	\$12.8 million paid in renewable energy incentives (associated emissions reductions not estimated)
Volume of Reductions	GHG reductions were not estimated.
Programmatic Status	The program is currently transitioning from the use of grants, rebates and other subsidies toward innovative low-cost financing.
Emissions Leakage	None noted.
New Jersey Clean Energy Program (funded by societal benefits charge)	
Cost of Reductions	\$29/mtCO₂e (cumulative lifetime reductions from 2001-2012 activities). ⁴⁶⁸
Volume of Reductions	60.9 MMTCO₂e cumulative lifetime reduction from 2001-2012 activities. ⁴⁶⁹
Programmatic Status	Companies that deliver program related services, including Program Managers, contractors, distributors, equipment manufacturers and retailers report overall program success. Most NJCEP programs are cost-effective based on TRC test, and participation goals were exceeded for most programs in 2010-2011. Total spending about 75-80 percent of budget. Areas for improvement include rebate processing time, marketing efforts, program longevity uncertainty. ⁴⁷⁰
Emissions Leakage	None noted.
Energy Trust of Oregon (funded by Public Purpose Charge)⁴⁷¹	

⁴⁶⁶ Connecticut Energy Efficiency Board. 2013. Connecticut Energy Efficiency Fund 2012 Programs and Operations Report. Accessed August 2013 at:

http://www.ctenergyinfo.com/FINAL%202012%20ALR%20Pages_2_18_13.pdf

⁴⁶⁷ Clean Energy Finance and Investment Authority. 2013. Progress Through Partnerships Annual Report Fiscal Year 2012. Accessed August 2013 at: <http://www.ctcleanenergy.com/annualreport/files/assets/downloads/publication.pdf>

⁴⁶⁸ NJ Clean Energy Program. 2013. NJCEP Cumulative Results 2000-2012. Accessed August 2013 at:

<http://www.njcleanenergy.com/files/file/2001-2012%20Program%20Results.xls>

⁴⁶⁹ Ibid

⁴⁷⁰ Applied Energy Group. 2012. Evaluation of New Jersey's Clean Energy Programs. Accessed August 2013 at:

<http://www.njcleanenergy.com/files/file/Library/NJ%20Program%20Analysis%20Final%20Report%206-11-12.pdf>

⁴⁷¹ Energy Trust of Oregon. 2013. 2012 Annual Report to the Oregon Public Utility Commission. Accessed August 2013 at:

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Cost of Reductions	\$99/mtCO₂e (for cumulative lifetime reductions and total spending of \$830 million from 2002-2012 activities).
Volume of Reductions	8.4 MMTCO₂e cumulative lifetime savings from 2002-2012.
Programmatic Status	Energy Trust has a 91 percent overall customer satisfaction rate according to a program survey. Electricity and natural gas energy efficiency savings and costs goals exceeded. Societal benefit to cost ratios range from 1.2-2.5 for various programs, and administrative costs are below program requirements. The program has generated significant positive economic and jobs impact.
Emissions Leakage	None noted.

14.3 Energy and Economic Impacts

Reports suggest significant energy and economic benefits from PBF-funded programs, including reduced electricity and fossil fuel consumption, increased renewable generation, job creation, and a bolstered economy. Annual distributions from California's PBF are many times higher than any other state. California requires the highest PBF surcharge, but this results in the greatest energy savings and job creation. Total electricity surcharges feeding into California's PBF were about \$0.0085/kWh in 2012.⁴⁷² California estimates that 2,800 direct and 4,500 indirect full-time jobs were sustained during 2012 as a result of the state's Public Interest Energy Research projects and in the long-term these projects would produce 27,700 direct, indirect, and induced jobs. In addition, CEC RD&D investments over 15 years totaled \$839 million and attracted \$1.35 billion in match funding.⁴⁷³ Oregon claims substantial economic and job creation benefits as well. Oregon estimates that \$830 million in energy investments from 2002-2012 have added \$2.8 billion to the state's economy and created nearly 23,000 full-time equivalent job-years.⁴⁷⁴ Table 40 summarizes the available energy and economic impact information for the California, Connecticut, New Jersey, and Oregon programs.

Table 40: Energy and Economic Impacts of Example Energy Programs Funded by Public Benefit Funds

California Energy Efficiency Program (funded by Public Goods Charge)⁴⁷⁵

http://energytrust.org/library/reports/2012_ETO_Annual_Report_OPUC1.PDF

⁴⁷² DSIRE. 2013. California Public Benefits Funds for Renewables and Efficiency. Accessed August 2013 at:

http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=CA05R

⁴⁷³ California Energy Commission. 2011. Renewable Energy Program 2011 Annual Report To The Legislature. Accessed August 2013 at: <http://www.energy.ca.gov/2011publications/CEC-300-2011-007/CEC-300-2011-007-CMF.pdf>

⁴⁷⁴ Energy Trust of Oregon. 2013. 2012 Annual Report to the Oregon Public Utility Commission. Accessed August 2013 at:

http://energytrust.org/library/reports/2012_ETO_Annual_Report_OPUC1.PDF

⁴⁷⁵ California Public Utilities Commission. 2012. 2010 – 2011 Energy Efficiency Annual Progress Evaluation Report. Accessed August 2013 at: <http://www.cpuc.ca.gov/NR/rdonlyres/89718A1B-C3D5-4E30-9A82-74ED155D0485/0/EnergyEfficiencyEvaluationReport.pdf>

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Independence from Fossil Fuels, and Economic Impact	84 million therms/yr reduction in natural gas use from 2010-2011 activities.
Impacts on Fuel Choice	None noted.
Opportunity for Investments in Infrastructure and Clean Energy/Energy Efficiency	\$1.6 billion spent from 2010-2011 for EE programs (\$1,460 million for programs that directly reduce emissions).
Impact on Different Sectors of the Economy	\$0.0054/kWh surcharge on electricity rates.
California Renewable Energy Program (funded by Public Goods Charge)⁴⁷⁶	
Independence from Fossil Fuels, and Economic Impact	Impact not quantified, but 127 MW and 87,400 GWh of renewable generation replaces what may have otherwise been fossil-based power
Impacts on Fuel Choice	Increased access to distributed renewables.
Opportunity for Investments in Infrastructure and Clean Energy/Energy Efficiency	None noted.
Impact on Different Sectors of the Economy	\$0.0016/kWh surcharge on electricity rates. Emerging Renewables Program: 28,673 systems installed, representing 127 MW of distributed capacity, with total disbursements of \$409 million from 1998-2011. Existing Renewable Facilities Program: Production incentives of \$326 million for 87,400 GWh (lifetime) of generation from 1998-2011.
California RD&D Program (funded by Public Goods Charge)⁴⁷⁷	
Independence from Fossil Fuels, and Economic Impact	None noted.
Impacts on Fuel Choice	None noted.
Opportunity for Investments in Infrastructure and Clean Energy/Energy Efficiency	Estimates developed by the California Clean Energy Future ⁴⁷⁸ , suggest that replacing natural gas energy generation with renewable generation will increase employment by 2.5 to 30 times relative to the natural gas generation scenario, depending on the type of renewable generation with energy efficiency measures. Similarly, replacing fossil fuel energy stands to increase the number of jobs 9 times.

⁴⁷⁶ California Energy Commission. 2011. Renewable Energy Program 2011 Annual Report To The Legislature. Accessed August 2013 at: <http://www.energy.ca.gov/2011publications/CEC-300-2011-007/CEC-300-2011-007-CMF.pdf>

⁴⁷⁷ California Energy Commission. 2013. Public Interest Energy Research 2012 Annual Report. Accessed August 2013 at: <http://www.energy.ca.gov/2013publications/CEC-500-2013-013/CEC-500-2013-013-CMF.pdf>

⁴⁷⁸ California Clean Energy Future - a collaboration of the California Air Resources Board, California Public Utilities Commission, California Energy Commission, California Environmental Protection Agency, and California Independent System Operator Corporation with the objective to advance carbon cutting innovation and green job creation through new investments in transmission, energy efficiency, smart grid applications, and increased use of renewable resources.

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Impact on Different Sectors of the Economy	Over 15 years, the CEC invested \$839 million for energy RD&D projects and attracted \$1.35 billion in match funding . Private rate of return on RD&D around 20-30 percent, social return is around 66 percent. In 2012, PIER projects sustained 2,800 direct and 4,500 indirect full-time jobs (27,700 direct, indirect, and induced jobs is projected long-term as a result of these projects). \$0.0015/kWh surcharge on electricity rates.
Connecticut Energy Efficiency Fund⁴⁷⁹	
Independence from Fossil Fuels, and Economic Impact	2012 activities resulted in 1.7 million mmBtu/yr savings and 19.8 million mmBtu lifetime savings from natural gas, fuel oil and propane.
Impacts on Fuel Choice	None noted.
Opportunity for Investments in Infrastructure and Clean Energy/Energy Efficiency	General job creation claimed. No specific information provided.
Impact on Different Sectors of the Economy	\$0.003/kWh surcharge on electricity rates.
Connecticut Clean Energy Fund⁴⁸⁰	
Independence from Fossil Fuels, and Economic Impact	4,648 kW of distributed solar PV capacity and 799 mmBtu/yr of solar thermal was incentivized and installed during FY 2012.
Impacts on Fuel Choice	Increased customer access to distributed solar PV and solar thermal
Opportunity for Investments in Infrastructure and Clean Energy/Energy Efficiency	None noted.
Impact on Different Sectors of the Economy	\$0.001/kWh surcharge on electricity rates.
New Jersey Clean Energy Program (funded by societal benefits charge)	
Independence from Fossil Fuels, and Economic Impact	124 million mmBtu of lifetime cumulative natural gas avoided from EE and RE activities during 2001-2012. ⁴⁸¹
Impacts on Fuel Choice	Very low participation in ground source heat pumps and solar hot water, both of which decrease natural gas consumption. ⁴⁸²

⁴⁷⁹ Connecticut Energy Efficiency Board. 2013. Connecticut Energy Efficiency Fund 2012 Programs and Operations Report. Accessed August 2013 at: http://www.ctenergyinfo.com/FINAL%202012%20ALR%20Pages_2_18_13.pdf

⁴⁸⁰ Clean Energy Finance and Investment Authority. 2013. Progress Through Partnerships Annual Report Fiscal Year 2012. Accessed August 2013 at: <http://www.ctcleanenergy.com/annualreport/files/assets/downloads/publication.pdf>

⁴⁸¹ NJ Clean Energy Program. 2013. NJCEP Cumulative Results 2000-2012. Accessed August 2013 at: <http://www.njcleanenergy.com/files/file/2001-2012%20Program%20Results.xls>

⁴⁸² Applied Energy Group. 2012. Evaluation of New Jersey's Clean Energy Programs. Accessed August 2013 at: <http://www.njcleanenergy.com/files/file/Library/NJ%20Program%20Analysis%20Final%20Report%206-11-12.pdf>

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Opportunity for Investments in Infrastructure and Clean Energy/Energy Efficiency	Development of contractor and supplier infrastructure, economic development ⁴⁸³ , and additional jobs for local construction trades; opportunities for EE and RE businesses (not quantified). ⁴⁸⁴
Impact on Different Sectors of the Economy	Surcharge increases electricity and NG rates by about 3.8 percent, ⁴⁸⁵
Energy Trust of Oregon (funded by Public Purpose Charge)⁴⁸⁶	
Independence from Fossil Fuels, and Economic Impact	From 2002 to 2012, cumulative savings reached 3,224 GWh/yr for electricity and 28.2 million therms/yr for natural gas. Cumulatively, renewable generation reached 964 GWh from 2002 to 2012.
Impacts on Fuel Choice	Support for large and small scale solar, small wind, hydro, and geothermal plus investments in dairy gas, wastewater treatment, and wood waste gasifier biopower.
Opportunity for Investments in Infrastructure and Clean Energy/Energy Efficiency	Wood waste gasification demonstration; Anaerobic digestion for electricity production at wastewater treatment plants; Small wind on farmland.
Impact on Different Sectors of the Economy	Since 2002, cumulatively added \$2.7 billion to local economy, including \$793 million in wages, \$155 million in small business income and 22,400 FTE job-years. Electricity surcharge increases rate by about 3%. Natural Gas surcharge increases rate by 1.25-1.5 percent. 74 percent of surcharge collections feed into Energy Trust.

14.4 Household Impacts and Co-Benefits

Energy efficiency and renewable programs funded by PBFs result in significant energy and energy cost savings for state residents. 2010-2011 energy efficiency activities in California saved nearly 600 GWh of electricity and about 21 million therms of natural gas per year.⁴⁸⁷ By comparison, Connecticut and Oregon each reduced annual electricity by about 140 GWh and natural gas by 8 million and 2.5 million therms, respectively from 2012 programs.^{488, 489}

⁴⁸³ Ibid

⁴⁸⁴ NJ Clean Energy Program. 2013. About NJCEP: Societal Benefits Charge. Accessed August 2013 at: <http://www.njcleanenergy.com/main/about-njcep/societal-benefits-charge/societal-benefits-charge-sbc>

⁴⁸⁵ Ibid

⁴⁸⁶ Energy Trust of Oregon. 2013. 2012 Annual Report to the Oregon Public Utility Commission. Accessed August 2013 at: http://energytrust.org/library/reports/2012_ETO_Annual_Report_OPUC1.PDF

⁴⁸⁷ California Public Utilities Commission. 2012. 2010 – 2011 Energy Efficiency Annual Progress Evaluation Report. Accessed August 2013 at: <http://www.cpuc.ca.gov/NR/rdonlyres/89718A1B-C3D5-4E30-9A82-74ED155D0485/0/EnergyEfficiencyEvaluationReport.pdf>

⁴⁸⁸ Connecticut Energy Efficiency Board. 2013. Connecticut Energy Efficiency Fund 2012 Programs and Operations Report. Accessed August 2013 at: http://www.ctenergyinfo.com/FINAL%202012%20ALR%20Pages_2_18_13.pdf

⁴⁸⁹ Energy Trust of Oregon. 2013. 2012 Annual Report to the Oregon Public Utility Commission. Accessed August 2013 at: http://energytrust.org/library/reports/2012_ETO_Annual_Report_OPUC1.PDF

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California strongly emphasizes the importance of energy innovation claiming that \$27.6 million invested in energy research from 1999 to 2008 will result in over \$10 billion in energy cost savings for state residents between 2005 and 2025.⁴⁹⁰ California and several other states also acknowledge air pollution co-benefits of energy efficiency and renewable energy programs. Specifically, these programs note reductions in NO_x, SO_x, particulate matter, and mercury emissions. Table 41 summarizes the available household impact and co-benefit information for the California, Connecticut, New Jersey, and Oregon programs.

Table 41: Household Impacts and Co-Benefits of Example Energy Programs Funded by Public Benefit Funds

California Energy Efficiency Program (funded by Public Goods Charge)⁴⁹¹	
Effect on Household Consumption and Spending	2010-2011 activities resulted in annual savings of 132 MW, 595 GWh, and 21 million therms in the residential sector.
Measures to Mitigate to Low-income Populations, or Economic Impact	None noted.
Significant Co-benefits	Reduction in pollutant emissions including NO _x , and PM10
California Renewable Energy Program (funded by Public Goods Charge)⁴⁹²	
Effect on Household Consumption and Spending	None noted
Measures to Mitigate to Low-income Populations, or Economic Impact	None noted
Significant Co-benefits	None noted
California RD&D Program (funded by Public Goods Charge)⁴⁹³	

⁴⁹⁰ California Energy Commission. 2013. Public Interest Energy Research 2012 Annual Report. Accessed August 2013 at: <http://www.energy.ca.gov/2013publications/CEC-500-2013-013/CEC-500-2013-013-CMF.pdf>

⁴⁹¹ California Public Utilities Commission. 2012. 2010 – 2011 Energy Efficiency Annual Progress Evaluation Report. Accessed August 2013 at: <http://www.cpuc.ca.gov/NR/rdonlyres/89718A1B-C3D5-4E30-9A82-74ED155D0485/0/EnergyEfficiencyEvaluationReport.pdf>

⁴⁹² California Energy Commission. 2011. Renewable Energy Program 2011 Annual Report To The Legislature. Accessed August 2013 at: <http://www.energy.ca.gov/2011publications/CEC-300-2011-007/CEC-300-2011-007-CMF.pdf>

⁴⁹³ California Energy Commission. 2013. Public Interest Energy Research 2012 Annual Report. Accessed August 2013 at: <http://www.energy.ca.gov/2013publications/CEC-500-2013-013/CEC-500-2013-013-CMF.pdf>

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Effect on Household Consumption and Spending	\$27.6 million invested in efficiency research from 1999-2008 is estimated to result in \$10.1 billion in benefits to ratepayers between 2005 and 2025 from 122,600 GWh of electricity savings and 1.1B therms of natural gas savings. PIER-funded demand response technologies are avoiding 260 MW of peak load annually and saved California electricity ratepayers an estimated \$16.5 million in 2012. By 2020, the effects of PIER synchrophasor research and related applications will save Californians an estimated \$210-\$360 million annually by improving reliability and avoiding costly outages and will provide \$90 million per year in other economic benefits.
Measures to Mitigate to Low-income Populations, or Economic Impact	None noted
Significant Co-benefits	None noted
Connecticut Energy Efficiency Fund⁴⁹⁴	
Effect on Household Consumption and Spending	The 2012 Residential Program served 500,836 customers, generating \$27.9M, 137 GWh, and 8 million therms of annual savings. Over the lifetime of these measures, savings are estimated to total \$276.4 million, 965.9 GWh, and 93M therms.
Measures to Mitigate to Low-income Populations, or Economic Impact	None noted.
Significant Co-benefits	2012 activities will result in lifetime air emissions reductions of 144 metric tons SOx and 288 metric tons NOx.
Connecticut Clean Energy Fund⁴⁹⁵	
Effect on Household Consumption and Spending	None noted.
Measures to Mitigate to Low-income Populations, or Economic Impact	None noted.
Significant Co-benefits	None noted.
New Jersey Clean Energy Program (funded by societal benefits charge)	
Effect on Household Consumption and Spending	Every dollar invested in the energy efficiency program returns \$4.00 in savings for the residential customer and \$11.00 in savings for the commercial and industrial customer. ⁴⁹⁶

⁴⁹⁴ Connecticut Energy Efficiency Board. 2013. Connecticut Energy Efficiency Fund 2012 Programs and Operations Report. Accessed August 2013 at: [http://www.ctenergyinfo.com/FINAL%202012%20ALR%20Pages 2 18 13.pdf](http://www.ctenergyinfo.com/FINAL%202012%20ALR%20Pages%202%2018%2013.pdf)

⁴⁹⁵ Clean Energy Finance and Investment Authority. 2013. Progress Through Partnerships Annual Report Fiscal Year 2012. Accessed August 2013 at: <http://www.ctcleanenergy.com/annualreport/files/assets/downloads/publication.pdf>

⁴⁹⁶ Applied Energy Group. 2012. Evaluation of New Jersey's Clean Energy Programs. Accessed August 2013 at: <http://www.njcleanenergy.com/files/file/Library/NJ%20Program%20Analysis%20Final%20Report%206-11-12.pdf>

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Measures to Mitigate to Low-income Populations, or Economic Impact	NJCEP offers EE home improvements, energy education, weatherization assistance; NJCEP spent \$256 million during 2001-2012 with lifetime cumulative savings of 1.3 million MWh and 13.4 million mmBtu. Low-income energy bill payment assistance (at least \$292 million in 2012 separate from NJCEP). ⁴⁹⁷
Significant Co-benefits	Overall reduction in pollutant emissions including NO _x , SO ₂ , and mercury. ⁴⁹⁸
Energy Trust of Oregon (funded by Public Purpose Charge)⁴⁹⁹	
Effect on Household Consumption and Spending	141 GWh and 2.5 million therms saved at nearly 17,000 new and existing homes that received Energy Trust services in 2012.
Measures to Mitigate to Low-income Populations, or Economic Impact	4.5 percent of public purpose charge dedicated to low-income housing plus \$10 million for electric-bill paying assistance; Program distributes energy-saver kits and offers increased incentive levels for low and moderate-income ratepayers.
Significant Co-benefits	None noted.

⁴⁹⁷ NJ Clean Energy Program. 2013. NJCEP Cumulative Results 2000-2012. Accessed August 2013 at: <http://www.njcleanenergy.com/files/file/2001-2012%20Program%20Results.xls>

⁴⁹⁸ Ibid

⁴⁹⁹ Energy Trust of Oregon. 2013. 2012 Annual Report to the Oregon Public Utility Commission. Accessed August 2013 at: http://energytrust.org/library/reports/2012_ETO_Annual_Report_OPUC1.PDF

15 Property Assessed Clean Energy (PACE) Programs

Policy Definition	Targeted Sector or Emissions
PACE programs provide or arrange for financing for home and/or building owners to install energy conservation or renewable energy measures. The loans are repaid through a property tax-like assessment with a term length of up to 20-years. These loans allow owners to pay for energy improvements over time, avoiding the barrier of upfront investment costs.	Electricity and natural gas consumption in RCI sector
GHGs and Costs	
<ul style="list-style-type: none"> • GHG reductions from existing programs are modest but may not reflect the full potential of PACE since these programs are in their infancy and often have limited funding. • Unlike utility energy programs funded through a system benefits charge or cost recovery rate adjustments assessed to all ratepayers, participation in PACE is voluntary. • PACE programs are typically authorized by state law but administered at the city or county level. This means that PACE programs limited costs at the state level once state legislation has been passed. Municipalities may be able to recover some or all administrative costs through application or project fees, increased interest rates, or other sources such as grants.⁵⁰⁰ 	
Implementation Issues and Lessons Learned	
<ul style="list-style-type: none"> • The Federal Housing Finance Agency currently prevents Fannie Mae and Freddy Mac from purchasing PACE encumbered mortgages which has essentially stalled residential PACE. • One of the primary challenges state and local programs face when launching a PACE program is acquiring seed funding, or a pool of funding dollars from which lending can occur. 	
Costs and Benefits to Consumers	Costs and Benefits to Businesses
<ul style="list-style-type: none"> • Increased access to energy conservation and distributed renewable technology incentives and financing. • Improved grid reliability and emissions rates. 	<ul style="list-style-type: none"> • Increased access to energy conservation and distributed renewable technology incentives and financing. • Increased access to energy research, development, deployment, and other business development funding. • Improved grid reliability and emissions rates. • Expanded clean energy talent pool and job creation.

Property assessed clean energy (PACE) programs operate by providing a unique loan mechanism to property owners for the deployment of energy efficient technologies and renewable energy at residential, commercial and industrial facilities. These loans allow owners to pay for energy improvements over time, avoiding the barrier of upfront investment costs.

The underlying PACE mechanism is and common to all programs: a local government provides or arranges for financing that is repaid with a property tax-like assessment with a term length of up to 20-years. PACE loans are different from other loans, since they typically stay with the

⁵⁰⁰ Sustainable Cities Institute. Property Assessed Clean Energy Program Overview. Accessed August 2013 online at: http://www.sustainablecitiesinstitute.org/view/page.basic/class/feature.class/Lesson_PACE_Financing

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property. If a homeowner sells their home before the loan is paid off, the loan can either be paid off at the time of sale or transferred with the property to the new owner. Each program is unique and will reflect different enabling acts, budgetary resources, program administration strategies, and level of community and local government support⁵⁰¹. By promoting energy conservation and renewable power generation, PACE programs capture energy cost savings and realize environmental co-benefits including reduced emissions from fossil energy consumption, water conservation and improved air quality.

Although PACE programs are often conducted at the local level, they must be authorized by state law. Today, 30 states and the District of Columbia can implement PACE programs. Early interest in PACE focused on the residential sector from 2008 through 2010. However, shortly after that the Federal Housing Finance Agency (FHFA) ordered Fannie Mae and Freddie Mac to stop buying PACE encumbered mortgages in July 2010 due to concerns regarding the structure of loans used to finance residential PACE programs. Specifically, the FHFA raised concerns regarding PACE loans that acquire a priority lien over existing mortgages. Unlike routine tax assessments, these priority liens pose risk management challenges for lenders, servicers and mortgage securities investors, but are not essential for PACE programs to spur fossil energy conservation.⁵⁰² As a result, state legislative efforts to enable PACE slowed in 2010. A few law suits have been filed in response to the FHFA's position on residential PACE but all have been unsuccessful. In March 2013, the Ninth Circuit ruled that the courts have no jurisdiction to interfere with FHFA's decision because the agency acted as a "conservator" of Fannie and Freddie, rather than as a regulator. Despite this challenge, some residential programs have continued to move forward with PACE loans receiving a subordinate lien position relative to existing mortgages. One drawback of this strategy is that the resulting increased risk to private investors significantly inhibits their interest in investing in PACE programs. The FHFA limitations do not affect commercial PACE. As more commercial PACE programs have launched and achieved early stage success in the last two years, interest in passing or amending flawed legislation has increased⁵⁰³.

One of the primary challenges states and municipalities face when launching PACE programs is acquiring seed funding. Many active PACE programs launched with seed funding provided by federal grants through the American Recovery and Reinvestment Act of 2009 (ARRA). However, ARRA funds and other potential federal funding sources have essentially dried up as a result of cuts to federal spending. Likewise, the recent economic recession in the U.S. has led to budgetary issues at the state and local government levels as well. Banks and private investment

⁵⁰¹ PACENow. 2013. Annual Report. Accessed August 2013 at:

<http://pacenow.org/wp-content/uploads/2013/06/Annual-report-6.18.13.pdf>

⁵⁰² Federal Housing Finance Agency (FHFA). FHFA Statement on Certain Energy Retrofit Loan Programs. (July 6, 2010). Accessed July 2013 at: <http://www.fhfa.gov/webfiles/15884/PACESTMT7610.pdf>

⁵⁰³ PACENow. 2013. Annual Report. Accessed August 2013 at: <http://pacenow.org/wp-content/uploads/2013/06/Annual-report-6.18.13.pdf>

firms have the potential to kick-start these programs, but currently stand on the sidelines pending the issuance of the FHFA's final rule regarding residential PACE.

Research conducted by ECONorthwest in April 2011 suggests that PACE programs have the potential to generate significant economic and fiscal impacts. Specifically, modeling of hypothetical PACE programs in Columbus, Ohio, Long Island, New York, Santa Barbara, California, and San Antonio, Texas indicates that \$4 million in total PACE project spending across the four cities (\$1 million in spending in each city) will generate \$10 million in gross economic output, \$1 million in combined federal, state and local tax revenue, and 60 jobs (about \$67,000 per job), on average.⁵⁰⁴

Household energy and energy cost savings achieved from this hypothetical PACE spending were not quantified; however, ECONorthwest did model the impacts of increased consumer spending for a single household achieving energy cost savings of \$1,000 per year for 25 years. It should be noted that the results of this modeling effort do not account for any utility revenue losses that would partially offset impacts of increased consumer spending, but ECONorthwest calculated gross spending effects at the local level of about \$21,000 in gross economic output, \$7,000 in personal income, \$3,000 in combined federal, state and local tax revenue, and 0.2 local jobs on average.⁵⁰⁵

15.1 Existing Policies

Currently, 30 states and the District of Columbia have legislation in place that allows municipalities to establish PACE funding programs to finance energy efficiency and renewable energy programs (see Figure 6). Collectively, these pieces of legislation encompass 80 percent of the U.S. population⁵⁰⁶. Many PACE programs are in their infancy and lack a significant portfolio of financed projects from which to gather data. In addition, many programs employ extremely lean operational strategies and avoid onerous reporting requirements as much as possible in an effort to maximize the utilization of available PACE financing for energy improvements. As a result, limited program performance data are available for PACE programs.

⁵⁰⁴ ECONorthwest. 2011. Economic Impact Analysis of Property Assessed Clean Energy Programs (PACE). Accessed August 2013 at:

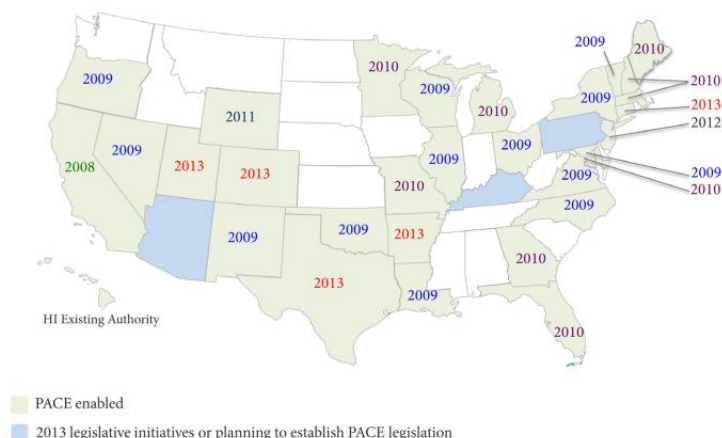
<http://pacenow.org/wp-content/uploads/2012/08/Economic-Impact-Analysis-of-Property-Assessed-Clean-Energy-Programs-PACE.pdf>

⁵⁰⁵ Ibid

⁵⁰⁶ PACENow. 2013. Annual Report. Accessed August 2013 at:

<http://pacenow.org/wp-content/uploads/2013/06/Annual-report-6.18.13.pdf>

Figure 6: PACE Legislative History in the U.S.⁵⁰⁷



The following list includes some example programs with published performance data:

- Maine PACE Loan Program⁵⁰⁸
- Boulder County, Colorado, ClimateSmart Loan Program (CSLP)⁵⁰⁹
- Sonoma County, California, Sonoma County Energy Independence Program (SCEIP)⁵¹⁰

Maine PACE Loan Program: Launched in April 2011, the Maine PACE Loan Program provides \$6,500 to \$15,000 loans to Maine homeowners to finance the cost of eligible energy saving improvements and offers repayment periods of 5, 10, or 15 years at a fixed interest rate of 4.99 percent APR, with no processing fees.⁵¹¹ PACE loans are available for residential buildings with one to four units that meet a set of minimum underwriting requirements and are located in municipalities that have passed a PACE ordinance. In addition, energy efficiency improvements packages must generate savings of at least 20 percent of home energy usage or 25 percent of heating and hot water energy usage to qualify for a PACE loan. PACE-eligible energy improvements include, but are not limited to: insulation, air sealing, energy efficient heating systems, lighting and appliances, windows and doors, and solar energy systems. Maine's PACE law dictates that loans do not have a senior priority over a primary home mortgage.⁵¹²

As of February 2013, a total of 158 Maine municipalities had passed PACE ordinances and entered into an agreement with Efficiency Maine to administer the loan program on their behalf. Residents of these towns comprise about three quarters of the state population and have

⁵⁰⁷ Ibid

⁵⁰⁸ Efficiency Maine. Accessed July 2013 at: <http://www.efficiencymaine.com/>

⁵⁰⁹ Boulder County ClimateSmart Loan Program. Accessed August 2013 at:

<http://www.bouldercounty.org/env/sustainability/pages/cslp.aspx>

⁵¹⁰ Sonoma County Energy Independence Program. Accessed August 2013 at: <http://www.sonomacountyenergy.org/>

⁵¹¹ DSIRE. 2013. Maine PACE Loans. Accessed August 2013 at:

http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=ME20F

⁵¹² Opinion Dynamics Corporation. 2013. Evaluation Of The Efficiency Maine Trust Pace Loan Program: Interim Impact Report. Accessed August 2013 at: <http://www.efficiencymaine.com/wp-content/uploads/2012/04/PACE-Interim-Impact-Report-FINAL.pdf>

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submitted a total of more than 1,800 loan applications⁵¹³. Efficiency Maine has established a \$20.4 million revolving loan fund for the PACE and PowerSaver Loan Program⁵¹⁴ primarily using Federal grant money through the DOE BetterBuildings Program. As homeowners pay back the loans, the loan fund will be replenished for the next round of homeowner applicants⁵¹⁵.

Boulder County, Colorado, ClimateSmart Loan Program (CSLP): The ClimateSmart Loan Program offered loans to Boulder County property owners who wanted to make energy efficiency and renewable energy improvements to their property. In June 2010, residential financing was cancelled and the loan program was put on-hold until issues with the FHFA and federal mortgage regulators, Fannie Mae and Freddie Mac, could be resolved. Subsequently, the commercial loan program was also suspended.⁵¹⁶

The Boulder County, Colorado, CLSP was the first test of PACE financing on a multi-jurisdictional level (involving individual cities as well as the county government). It was also the first PACE program to comprehensively address energy efficiency measures and renewable energy, and it was the first funded by a public offering of both taxable and tax-exempt bonds. Initiated in 2009, the first phase of the CSLP included two rounds of residential project financing and resulted in about \$9.8 million in project loans. Associated program costs and fees and funding of a reserve account for the bonds added \$3.2 million, for a total of about \$13 million in Phase 1 program spending.⁵¹⁷

The minimum borrowing level for the first phase of the CLSP was \$3,000 per home. The maximum borrowing limit for open loans (using taxable bonds), was the lesser of 20 percent of actual property value, or \$50,000. For income-qualified loans (using tax-exempt bonds), the maximum borrowing limit was set to \$15,000 per home. Interest rates on PACE loans ranged from 5.2 percent to 6.8 percent depending on the type of bond and the issue. PACE loans were repaid through a 15-year assessment on each participant's property taxes (senior lien). If a property owner sells a PACE-assessed home or business, the assessment stays with the property, with responsibility passing to the next owner until the debt is paid.⁵¹⁸

Sonoma County, California, Sonoma County Energy Independence Program (SCEIP): Sonoma County's Energy Independence Program gives residential and non-residential property

⁵¹³ Ibid

⁵¹⁴ The PowerSaver Loan Program covers the same home energy improvements as PACE, but offers a wider range of loan amounts, is available statewide, and has slightly different eligibility criteria.

⁵¹⁵ Opinion Dynamics Corporation. 2013. Evaluation Of The Efficiency Maine Trust Pace Loan Program: Interim Impact Report. Accessed August 2013 at: <http://www.efficiencymaine.com/wp-content/uploads/2012/04/PACE-Interim-Impact-Report-FINAL.pdf>

⁵¹⁶ Boulder County, Colorado Website. Accessed August 2013 at: <http://www.bouldercounty.org/env/sustainability/pages/cslp.aspx>

⁵¹⁷ National Renewable Energy Laboratory. 2011. Economic Impacts from the Boulder County, Colorado, ClimateSmart Loan Program: Using Property-Assessed Clean Energy (PACE) Financing. Accessed August 2013 at: <http://www.nrel.gov/docs/fy11osti/52231.pdf>

⁵¹⁸ Ibid

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owners the option of financing energy efficiency, water efficiency and renewable energy improvements through a voluntary assessment on their property tax bills. The property tax assessments are attached to the property, not the property owner, meaning that if the property is sold, the assessment stays with the property. In 2010, Sonoma County's PACE program was temporarily suspended in response to the FHFA's statement of concerns regarding residential PACE financing on July 10, 2010 but was immediately re-opened by the Sonoma County Board of Supervisors on July 13, 2010.⁵¹⁹

The minimum funding level offered by SCEIP is \$2,500 and assessments may not exceed 10 percent of the property value⁵²⁰. In addition, the sum of all debt associated with the property cannot exceed 100 percent of the value of the property at the time loan is made.⁵²¹ This assessment is final regardless of whether or not the property value decreases⁵²². The SCEIP can be combined with utility and state rebates, but financing will only be available for the post-incentive cost. Tax credits will not affect the amount of financing available⁵²³. The repayment period is 10 years for amounts from \$2,500 to \$4,999 and projects over \$5,000 may be repaid over a term of either 10 or 20 years, at the property owner's option. Projects of \$60,000 up to \$500,000 require approval by the Program Administrator, and projects over \$500,000 require specific approval by the Board of Supervisors. The current interest rate for SCEIP assessment contracts is 7 percent simple interest. The interest rate is fixed at the time the assessment contract and implementation agreement are signed and will not rise.⁵²⁴

Commercial and industrial properties must first have an energy audit before participating in the program. Energy audits are not required for residential participants, but they are strongly recommended. Beginning March 1, 2011, the SCEIP offers rebates of up to 75 percent for the cost of energy analyses performed by certified raters.⁵²⁵

A key SCEIP enhancement effective July 1, 2011, is the requirement of achieving 10 percent energy efficiency improvement on the property prior to (or along with) the financing of

⁵¹⁹ DSIRE. 2013. Sonoma County – Energy Independence Program. Accessed August 2013 at: http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=CA188F

⁵²⁰ Sonoma County Energy Independence Program FAQs. Accessed August 2013 at: <http://residential.sonomacountyenergy.org/lower.php?url=faqs-75>

⁵²¹ DSIRE. 2013. Sonoma County – Energy Independence Program. Accessed August 2013 at: http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=CA188F

⁵²² University of San Diego Energy Policy Initiatives Center. 2013. Residential and Commercial Property Assessed Clean Energy (PACE) Financing in California. Accessed September 2013 at: <http://energycenter.org/sites/default/files/docs/nav/policy/research-and-reports/PACE%20in%20California.pdf>

⁵²³ DSIRE. 2013. Sonoma County – Energy Independence Program. Accessed August 2013 at: http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=CA188F

⁵²⁴ Sonoma County Energy Independence Program FAQs. Accessed August 2013 at: <http://residential.sonomacountyenergy.org/lower.php?url=faqs-75>

⁵²⁵ DSIRE. 2013. Sonoma County – Energy Independence Program. Accessed August 2013 at: http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=CA188F

renewable generation upgrade projects. This approach supports SCEIP’s regional goal to “reduce and produce,” and it strengthens the market position of the SCEIP assessment portfolio.⁵²⁶

15.2 GHG Impacts

PACE programs reduce GHGs from fossil energy consumption by providing financing to home and building owners to make energy efficiency improvements and install renewable energy technologies. GHG savings were not reported in published program reports, but were calculated externally for the Maine PACE and ClimateSmart Loan Programs based on reported energy savings and some basic assumptions detailed below. Estimated gross annual GHG reductions achieved by each program are just over 1,000 mtCO₂e per year. Since PACE programs provide “financing” as opposed to “funding,” the cost of these reductions is minimal and includes general administrative costs, the development of a risk-management reserve fund, loan fees, and other related costs.

Table 42: GHG Costs and Benefits of Example PACE Programs

Maine PACE Loan Program⁵²⁷	
Cost of Reductions	Loan program (no cost other than administrative costs). Administrative costs not presented.
Volume of Reductions	1,200 mtCO₂e/yr (gross) and 1,300 mtCO₂e/yr (net) from projects completed April 2011 to September 2012. ⁵²⁸
Programmatic Status	For FY 2012, the program was cost-effective for the following three tests: Total Resource Cost (TRC) ⁵²⁹ = 1.61, Program Administrator Cost Test (PACT) ⁵³⁰ = 4.80, Participant Cost Test (PCT) ⁵³¹ = 2.27
Emissions Leakage	None Noted.
ClimateSmart Loan Program, Boulder County, CO⁵³²	

⁵²⁶ Ibid

⁵²⁷ Opinion Dynamics Corporation. 2013. Evaluation Of The Efficiency Maine Trust Pace Loan Program: Interim Impact Report. Accessed August 2013 at: <http://www.efficiencymaine.com/wp-content/uploads/2012/04/PACE-Interim-Impact-Report-FINAL.pdf>

⁵²⁸ Estimates external to study using the following assumptions: all savings are from primary heating fuel (savings by fuel are 90% fuel oil, 5% NG, 5% Propane); 2013 Climate Registry default emission factors for CO₂, CH₄, and N₂O; IPCC Second Assessment Report GWPs.

⁵²⁹ Total Resource Cost Test - The TRC examines the costs and benefits of an energy efficiency program from a societal perspective. It compares net energy-savings benefits (avoided costs) to the net costs incurred by the program administrator as well as net costs incurred by the participant, such as the incremental cost of purchasing the program measure. The TRC views program incentives/rebates as transfers at the societal level and not as program costs.

⁵³⁰ Program Administrator Cost Test - The PACT examines the costs and benefits from the perspective of the program administrator. It compares the net benefits to the net costs incurred by the program administrator, including any rebate/incentive costs but excluding any net costs incurred by the participant, such as the actual measure cost.

⁵³¹ Participant Cost Test - The PCT examines the costs and benefits from the perspective of the customer installing the energy efficiency measure (homeowner, business, etc.). Benefits include bill savings realized by the customer from reduced energy consumption and the incentives received by the customer, including any applicable tax credits. Costs include the incremental costs of purchasing and installing the efficient equipment, above the cost of standard equipment, that are borne by the customer. In some cases incremental operations and maintenance costs (or savings) are also included.

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Cost of Reductions	CLSP financed (lending) \$9.8 million in residential energy retrofits. \$2.4 million was set aside to serve as a reserve fund. About \$0.8 million was used for administrative costs, loan fees, and other costs.
Volume of Reductions	1,100 mtCO₂e/yr (gross) ⁵³³
Programmatic Status	The CSLP achieved all key qualitative goals: (1) reducing GHG emissions, (2) improving the environment, (3) saving energy, and (4) providing direct and indirect economic benefits.
Emissions Leakage	None noted.
Sonoma County Energy Independence Program, Sonoma County, CA ⁵³⁴	
Cost of Reductions	From March 2009 to March 2013, received 2,640 PACE financing applications for \$96 million in renewable energy, energy efficiency and water conservation improvements. More than \$66 million has been approved, and over \$61 million has been disbursed to projects that are completed. Approximately \$9.6 million of the assessments have been fully paid off, which has provided a like amount to be made available for additional projects.
Volume of Reductions	An effort by the County to quantify the energy savings and GHG reduction for financed energy efficiency and water conservation projects is currently underway.
Programmatic Status	The program has improved energy efficiency, increased renewable energy generation, GHG reductions, water conservation, and added local jobs. Currently, there are efforts to expand program.
Emissions Leakage	None noted.

15.3 Energy and Economic Impacts

Generally, the low interest rates and relatively long repayment terms mean the PACE programs can create an immediate positive cash flow to building owners. In other words, energy cost savings achieved through PACE-financed energy improvements can exceed loan repayment costs on an annual basis resulting in net savings even during repayment years. These benefits will continue to accrue after loan repayment is complete.

All three PACE programs analyzed here generated positive economic output, added jobs, and reduced energy consumption or added renewable energy capacity. The Maine PACE Loan

⁵³² National Renewable Energy Laboratory. 2011. Economic Impacts from the Boulder County, Colorado, ClimateSmart Loan Program: Using Property-Assessed Clean Energy (PACE) Financing. Accessed August 2013 at: <http://www.nrel.gov/docs/fy11osti/52231.pdf>

⁵³³ Estimate external to study using the following assumptions: average participant savings of 1,786 kWh/yr for electricity and 74.9 therms/yr for natural gas; eGRID2012 electricity CO₂e emission factor for WECC Rockies subregion; 2013 Climate Registry default natural gas emission factors for CO₂, CH₄, and N₂O, IPCC Second Assessment Report GWPs.

⁵³⁴ Sonoma County Energy Independence Program. 2013. Sonoma County Energy Independence Program Activity Update. Accessed August 2013 at: http://www.drivecms.com/uploads/sonomacountyenergy.org/Reports/032613_GSD%20SCEIPupdate_attA.pdf

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Program achieved verified gross energy savings of over 16,000 mmBtu predominantly through reduced fuel oil consumption. ClimateSmart program participants realized gross first-year electricity and natural gas savings of 1.1 GWh and 4,500 mmBtu, respectively. An effort to quantify the energy savings for PACE-financed energy efficiency and water conservation projects is currently underway in Sonoma County, California but the program did report financing over 1,100 solar installations that generate about 8.3 kW annually.

Table 43: Energy and Economic Impacts of Example PACE Programs

Maine PACE Loan Program⁵³⁵	
Independence from Fossil Fuels, and Economic Impact	Verified first-year, annual gross savings for the PACE/PowerSaver Program are 16,332 mmBtu for the 284 projects completed April 2011 through September 2012.
Impacts on Fuel Choice	None noted.
Opportunity for Investments in Infrastructure and Clean Energy/Energy Efficiency	Total PACE/PowerSaver FY2012 program spending of \$3.4 million (excluding adjustments for early retirement, economic cost of lending, and evaluation costs) resulted in the creation of an estimated 238 FTE job-years.
Impact on Different Sectors of the Economy	Total PACE/PowerSaver FY2012 program spending of \$3.4 million (excluding adjustments for early retirement, economic cost of lending, and evaluation costs) resulted in an estimated \$15.6 million increase in Gross State Product.
ClimateSmart Loan Program, Boulder County, CO⁵³⁶	
Independence from Fossil Fuels, and Economic Impact	Gross first-year electricity and NG savings of 1.1 GWh/yr and 4,500 mmBtu/yr , respectively.
Impacts on Fuel Choice	Increased access to residential solar PV.
Opportunity for Investments in Infrastructure and Clean Energy/Energy Efficiency	\$13 million spent in financing and program costs supported 85 jobs (57 percent were solar PV-related jobs) in Boulder County (about 6.5 jobs/\$1 million of investment) and 126 jobs in the state as a whole (about 9.7 jobs/\$1 million of investment). Wage and salary earnings increased by \$5.1 million in Boulder County and \$7.1 million for the state as a whole in the short term.
Impact on Different Sectors of the Economy	Economic activity increased by almost \$14 million in Boulder County and almost \$20 million for the state as a whole. The study claims cash spending and alternatively financed spending probably increased the total of all program-related spending by 20 percent or more.
Sonoma County Energy Independence Program, Sonoma County, CA⁵³⁷	

⁵³⁵ Opinion Dynamics Corporation. 2013. Evaluation Of The Efficiency Maine Trust Pace Loan Program: Interim Impact Report. Accessed August 2013 at: <http://www.efficiencymaine.com/wp-content/uploads/2012/04/PACE-Interim-Impact-Report-FINAL.pdf>

⁵³⁶ National Renewable Energy Laboratory. 2011. Economic Impacts from the Boulder County, Colorado, ClimateSmart Loan Program: Using Property-Assessed Clean Energy (PACE) Financing. Accessed August 2013 at: <http://www.nrel.gov/docs/fy11osti/52231.pdf>

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Independence from Fossil Fuels, and Economic Impact	The program currently is serving 1,841 participating property owners, completing over 1,800 energy efficiency projects and 1,100 solar installations, and generating 8.3kW of energy annually. An effort to quantify the energy savings and GHG reduction for financed energy efficiency and water conservation projects is currently underway.
Impacts on Fuel Choice	Increased access to distributed renewable generation.
Opportunity for Investments in Infrastructure and Clean Energy/Energy Efficiency	The \$61 million invested locally has energized the creation of an active energy efficiency and renewable energy construction market. Opportunity exists for collaboration and partnership with private PACE program providers to expand the options that could be used to secure funds and increase Program funding capacity.
Impact on Different Sectors of the Economy	86 percent of PACE-financed projects have been installed by local contractors. This has led to the creation of approximately 77 local jobs within the related industry sectors that are engaged with program.

15.4 Household Impacts and Co-Benefits

Households that took advantage of PACE financing in Maine were reported to have saved over 28 percent of whole-house energy usage on average. Program participants in Boulder, Colorado were reported to have saved nearly 1,800 kWh of electricity and 75 mmBtu of natural gas per year on average, resulting in annual energy cost savings of about \$208 per participant. Boulder and Sonoma Counties also report (but do not quantify) program co-benefits that include water conservation and improved air quality.

Table 44: Household Impacts and Co-Benefits of Example PACE Programs

Maine PACE Loan Program ⁵³⁸	
Effect on Household Consumption and Spending	57.5 mmBtu gross savings for each of the 284 projects completed April 2011 through September 2012. On average, these savings represent 28.6 percent of pre-project whole-house energy usage.
Measures to Mitigate to Low-income Populations, or Economic Impact	None noted.
Significant Co-benefits	None noted.
ClimateSmart Loan Program, Boulder County, CO ⁵³⁹	

⁵³⁷ Sonoma County Energy Independence Program. 2013. Sonoma County Energy Independence Program Activity Update. Accessed August 2013 at:

http://www.drivecms.com/uploads/sonomacountyenergy.org/Reports/032613_GSD%20SCEIPupdate_attA.pdf

⁵³⁸ Opinion Dynamics Corporation. 2013. Evaluation Of The Efficiency Maine Trust Pace Loan Program: Interim Impact Report. Accessed August 2013 at: <http://www.efficiencymaine.com/wp-content/uploads/2012/04/PACE-Interim-Impact-Report-FINAL.pdf>

⁵³⁹ National Renewable Energy Laboratory. 2011. Economic Impacts from the Boulder County, Colorado, ClimateSmart Loan Program: Using Property-Assessed Clean Energy (PACE) Financing. Accessed August 2013 at: <http://www.nrel.gov/docs/fy11osti/52231.pdf>

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Effect on Household Consumption and Spending	Reduced energy use saved participants a combined total of about \$124k/yr (\$208/yr per participant) during the first year on their electric and gas utility bills. Average participant savings were 1,786 kWh/yr for electricity and 74.9 therms/yr for NG.
Measures to Mitigate to Low-income Populations, or Economic Impact	2008 ballot measure that funded the CSLP authorized Boulder County to issue up to \$40 million in bonds, including \$14 million in tax-exempt bonds intended for low-income-qualified projects.
Significant Co-benefits	Reduced environmental impacts, such as air pollution and water use.
Sonoma County Energy Independence Program, Sonoma County, CA⁵⁴⁰	
Effect on Household Consumption and Spending	An effort to quantify the energy savings and GHG reduction for financed energy efficiency and water conservation projects is currently underway.
Measures to Mitigate to Low-income Populations, or Economic Impact	None noted.
Significant Co-benefits	Water conservation (not quantified).

⁵⁴⁰ Sonoma County Energy Independence Program. 2013. Sonoma County Energy Independence Program Activity Update. Accessed August 2013 at: http://www.drivecms.com/uploads/sonomacountyenergy.org/Reports/032613_GSD%20SCEIPupdate_attA.pdf

16 Feed-in-Tariffs

Policy Definition	Targeted Sector or Emissions
A FiT is a policy mechanism designed to accelerate investment in and deployment of renewable energy technologies by offering long-term contracts with a set price to renewable energy producers. The FiT provides certainty to potential energy producers by establishing guaranteed price schedules and eliminating the need for contractual negotiations with utilities, for eligible projects.	Electricity Generation
GHGs and Costs	
<ul style="list-style-type: none"> Cost of reductions in Germany for solar in 2010 was €537 or (\$714)/mtCO₂e while the cost of reductions for wind in 2010 was €44 or (\$58.5)/ mtCO₂e.⁵⁴¹ In Germany, 2010 reductions from solar was 7 million tCO₂e while the volume of reductions for wind in 2010 was 27 millions tCO₂e.⁵⁴² In California in 2012, FiT rates ranged from \$0.77/kWh to \$0.93/kWh depending on the contract period.⁵⁴³ 	
Implementation Issues and Lessons Learned	
<ul style="list-style-type: none"> The success of a FIT policy depends on many variables, including existing renewable energy generation, community acceptance of renewable energy and associated costs, and interconnection codes and standards.⁵⁴⁴ A 2010 World Future Council study found that FITs with the following attributes are more successful in deploying renewable energy; notably programs without program caps or project-size caps, with longer contract terms, with more technologies, with tariffs based on the cost of generation rather than avoided cost, with more differentiation in the tariffs and with sufficient inflation indexing.⁵⁴⁵ Program caps serve to moderate the potential cost to ratepayers and system integration impacts of introducing a large number of FIT-funded renewable resources, while project caps can serve to moderate the number of large projects and/or broaden the type of technologies.⁵⁴⁶ A focus on small-scale projects can lead to big-scale achievements; for example almost all Ontario solar projects are 10 MW and smaller (a third are 10 kW and smaller) and yet Ontario's installed capacity ranks #4 in North America, behind California, Arizona, and New Jersey.⁵⁴⁷ Setting payment schedules has proved challenging as payments need to be high enough to attract investors without resulting in windfall profits and undue burden on ratepayers.⁵⁴⁸ 	

⁵⁴¹ Marcantonini and Ellerman. The Cost of Abating CO₂ Emissions by Renewable Energy Incentives in Germany. Accessed August 2013 at: http://cadmus.eui.eu/bitstream/handle/1814/25842/RSCAS_2013_05rev.pdf?sequence=1

⁵⁴² Ibid.

⁵⁴³ California Public Utilities Commission, <http://www.cpuc.ca.gov/PUC/energy/Renewables/Feed-in+Tariff+Price.htm> accessed 8/12/13

⁵⁴⁴ The National Association of Regulatory Utility Commissioners (NARUC). *Feed-in Tariffs: Frequently Asked Questions for State Utility Commissions*. June 2010. Report accessed August 2013 at <http://www.naruc.org/Publications/NARUC%20Feed%20in%20Tariff%20FAQ.pdf>

⁵⁴⁵ The World Future Council. *Grading North American Feed-in Tariffs*. May 2010. Report accessed August 2013 at http://www.worldfuturecouncil.org/fileadmin/user_upload/PDF/Grading_N.Am_FITs_Report.pdf

⁵⁴⁶ NARUC. *Feed-in Tariffs: Frequently Asked Questions for State Utility Commissions*. June 2010.

⁵⁴⁷ Institute for Self Reliance. *Expect Delays - Reviewing Ontario's "Buy Local" Renewable Energy Program*. May 2013. Report accessed August 2013 at <http://www.ilsr.org/wp-content/uploads/2013/05/expect-delays-ontario-fit-ilsr-2013.pdf>

⁵⁴⁸ NARUC. *Feed-in Tariffs: Frequently Asked Questions for State Utility Commissions*. June 2010.

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<ul style="list-style-type: none"> • Incentives for distributed generation and commitment to local ownership can spur economic development; notably by attracting private sector investment, drawing clean energy companies and associated industries and creating jobs. • Policy areas often identified as complicating the development of renewable energy resources affecting the effectiveness of a FIT include interconnection codes, standards and practices, metering requirements and the siting process for renewable energy systems.⁵⁴⁹ • A 2010 report by the The National Association of Regulatory Utility Commissioners found that the key elements of a successful FiT include longer contract length, interconnection rules and agreements, program and project caps, tariff revisions, payment differentiation and bonus payments.⁵⁵⁰ 	
Costs and Benefits to Consumers	Costs and Benefits to Businesses
<ul style="list-style-type: none"> • As FIT programs are supported by ratepayers through above-market costs, electricity rates are likely to increase. • The resulting impact to the average household electricity bill is undetermined in the U.S., as FIT programs are still in their infancy.⁵⁵¹ • Germany's FIT cost consumers a 3% rate increase in the lifetime of the program, with a 5% increase in 2008 alone, averaging \$2.66 to \$8.00 per month.⁵⁵² 	<ul style="list-style-type: none"> • As FIT programs are supported by ratepayers through above-market costs, electricity rates are likely to increase. • As FIT programs are still in their infancy in the US, the impact to businesses is still undetermined.

A feed-in tariff (FIT) is a policy mechanism designed to accelerate investment in and deployment of renewable energy technologies by offering long-term contracts with a set price to renewable energy producers. The FIT provides certainty to potential energy providers by establishing guaranteed price schedules and eliminating the need for contractual negotiations with utilities, for eligible projects.

16.1 Existing Policies

FITs are used to a limited extent around the United States, but they are more common internationally. Historically, FITs have been associated with a German model in which the government mandates that utilities enter into long-term contracts with generators at specified rates, typically well above the retail price of electricity. In the United States, where FITs are comparatively new, FITs or similarly structured programs are mandated to varying degrees in a limited number of states. However, a different model has also emerged in which utilities independently establish a utility-level FIT, either voluntarily or in response to state or local

⁵⁴⁹ NARUC. *Feed-in Tariffs: Frequently Asked Questions for State Utility Commissions*. June 2010.

⁵⁵⁰ NARUC. *Feed-in Tariffs: Frequently Asked Questions for State Utility Commissions*. June 2010.

⁵⁵¹ NARUC. *Feed-in Tariffs: Frequently Asked Questions for State Utility Commissions*. June 2010.

⁵⁵² NARUC. *Feed-in Tariffs: Frequently Asked Questions for State Utility Commissions*. June 2010.

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government mandates⁵⁵³. This section reviews FIT programs in Germany, Ontario, and California.

Germany

The Renewable Energy Sources Act, also known as EEG (Erneuerbare-Energien-Gesetz) law, has enabled renewable energy investments in large scale throughout Germany through the use of FITs. In 2011, the FIT program rates were significantly enhanced as part of a government policy, called “Energiewende”, to accelerate the phase out of eight nuclear plants totaling 20.9 GW of electric power generation capacity.⁵⁵⁴ Amendments in 2012 increased the term of the FIT guaranteed rate from 15 years to 20 years for some installations, designed to spur new projects and investments in Germany, particularly smaller ones. FIT rates vary based on source fuels, such as hydropower, land fill gas, sewage gas, mine gas, biomass (bio waste and small manure biogas), geothermal, on-shore wind, off-shore wind, and solar. There is also a lower tariff provided for self-consumption at certain sites.

Germany has established fixed FIT rates for 2012 to 2021, providing clear long term investment protection and guidance for developers, though these rates fluctuate based on technology, installation size, and are based on levelized project costs. With the new amended and enhanced rates, Solar Photovoltaic (PV) has become a very attractive technology. Renewable energy accounted for total investment of €22.9 Billion in 2011, with PVs accounting for €15.0 Billion. The total economic output of German based renewable energy manufactures and installers was €24.94 Billion, including exports.⁵⁵⁵

By 2020, the goal is to have 14% of total energy sourced from renewables, which will be achieved by using renewables to provide 35% of electricity, 18% of thermal energy and 10% in transportation sector, leading to a 40% reduction in greenhouse gases when compared to 1990 standards. The renewable energy source goals increase incrementally each decade thereafter until 2050 when renewables are expected to provide 80% of the electricity, 60% of thermal energy. With 25% reduction through efficiency, the overall reduction in GHG is anticipated to be 80% to 95% by 2050.⁵⁵⁶

Ontario

In November 2006, the Ontario Power Authority (OPA) launched the Renewable Energy Standard Offer Program (RESOP) to develop distributed (10 MW and smaller) renewable energy

⁵⁵³ EIA. May 2013. Feed-in tariff: A policy tool encouraging deployment of renewable electricity technologies. Accessed August 2013 at: <http://www.eia.gov/todayinenergy/detail.cfm?id=11471>

⁵⁵⁴ <http://energytransition.de/>

⁵⁵⁵ Sullivan et al. Gross employment from renewable energy in Germany in 2011. March 2012. Accessed August 13, 2013. http://www.erneuerbare-energien.de/fileadmin/ee-import/files/english/pdf/application/pdf/ee_bruttobeschaeftigung_en_bf.pdf

⁵⁵⁶ AGEE-Stat 2013. Renewable Energy Sources in Germany – Key information 2012 at a glance. February 2013. http://www.erneuerbare-energien.de/fileadmin/Daten_EE/Dokumente_PDFs_/20130328_hgp_e_tischvorlage_2012_bf.pdf

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projects by using a standardized, fixed price, long-term contract. While RESOP attracted investment in renewable energy, contracting nearly 1,400 MW of wind (56%), solar (34%), bioenergy and hydropower power projects, execution was problematic largely and after 18 months only 34 MW out of 1,400 MW reached operation.⁵⁵⁷

In early 2009, advocates of expanding and improving the RESOP program won passage of the Green Energy & Green Economy Act, establishing Ontario's FIT program designed to create new clean energy industries and jobs, boost economic activity and the development of renewable energy technologies, and improve air quality by phasing out coal-fired electricity generation by 2014.⁵⁵⁸ Qualifying renewable technologies include biogas, renewable biomass, landfill gas, solar photovoltaic (PV), hydro power and wind power.⁵⁵⁹ The Ontario Power Authority (OPA) is responsible for implementing the FiT Program. Within two years OPA signed about 2,000 small and large FIT contracts with clean energy producers totaling approximately 4,600 MW.⁵⁶⁰ Ontario's FIT program has played a significant role in jumpstarting renewable energy, ranking #4 and #11 in North America for solar and wind deployment. It has also enabled widespread participation in renewable energy generation with 1 in 7 Ontario farmers participating and earning a return on their investment.⁵⁶¹

FIT Program has been key to making Ontario a leader in clean energy production and manufacturing. FIT attracted more than \$20 billion in private sector investment to Ontario during challenging economic times, welcomed more than 30 clean energy companies to the province as of 2011⁵⁶² and created more than 31,000 jobs as of 2013.⁵⁶³ By the end of 2014, Ontario will be the first jurisdiction in North America to replace coal-fired generation with cleaner sources of power.⁵⁶⁴ Ontario has shut down 10 of 19 coal units and reduced the use of coal by nearly 90 per cent since 2003.⁵⁶⁵ Moreover, Ontario is on track to procure 10,700 MW of non-hydro renewable energy generation by 2015.⁵⁶⁶ To support the long-term sustainability of the FiT Program, OPA

⁵⁵⁷ Institute for Self Reliance. *Expect Delays - Reviewing Ontario's "Buy Local" Renewable Energy Program*. May 2013. Report accessed August 2013 at <http://www.ilsr.org/wp-content/uploads/2013/05/expect-delays-ontario-fit-ilsr-2013.pdf>

⁵⁵⁸ <http://www.energy.gov.on.ca/en/fit-and-microfit-program/2-year-fit-review/>

⁵⁵⁹ Ontario Power Authority. Feed-In Tariff (FIT) Program, FAQs. Accessed August 12, 2013. <http://fit.powerauthority.on.ca/faqs>

⁵⁶⁰ Ontario. *Ontario's Feed-in Tariff Program Building Ontario's Clean Energy Future - Two-Year Review Report*. March 2012. <http://www.energy.gov.on.ca/docs/en/FIT-Review-Report-en.pdf>

⁵⁶¹ Institute for Self Reliance. *Expect Delays - Reviewing Ontario's "Buy Local" Renewable Energy Program*. May 2013.

⁵⁶² <http://www.energy.gov.on.ca/en/fit-and-microfit-program/2-year-fit-review/>

⁵⁶³ <http://www.energymanagertoday.com/ontarios-buy-local-feed-in-tariff-stuck-in-a-rut-after-initial-success-092031/>

⁵⁶⁴ Ontario. *Ontario's Feed-in Tariff Program Building Ontario's Clean Energy Future - Two-Year Review Report*. March 2012.

⁵⁶⁵ Ontario. *Ontario's Feed-in Tariff Program Building Ontario's Clean Energy Future - Two-Year Review Report*. March 2012.

⁵⁶⁶ Ontario. *Ontario's Feed-in Tariff Program Building Ontario's Clean Energy Future - Two-Year Review Report*. March 2012.

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has set annual procurement targets of 150 megawatts for small FiT and 50 megawatts for microFiT for each of the next four years, beginning in 2014.

The biggest challenge for the FIT program is the overwhelming demand. Signed contracts for nearly 5,000 megawatts of new renewable energy capacity will allow the province to meet most of its 2030 renewable energy target, 12 years early.⁵⁶⁷ While Ontario's FIT program has stumbled with less than 10 percent of its contracted capacity deployed, it remains competitive with leading U.S. states.⁵⁶⁸

In addition, the revision of tariffs may have affected investors and created some instability in the policy environment. In late 2010, the OPA lowered contract price to reflect better economics. While tariff revisions may ensure probability and program sustainability, they should be clearly communicated to investors to maintain a stable policy environment.⁵⁶⁹

California

On February 14, 2008, the California Public Utilities Commission (CPUC) authorized the purchase of up to 480 MW of renewable generating capacity from renewable facilities smaller than 1.5 MW. The FiT provides a mechanism for small renewable generators to sell power to the utility at predefined terms and conditions, without contract negotiations, setting the price paid to small generators at the level of the Market Price Referent (MPR). In 2009, eligible project size was increased to 3 MW.⁵⁷⁰ The original FiT program closed on July 24, 2013, and was replaced by a renewable market adjusting tariff (ReMAT).

In May 2012, the CPUC implemented a new pricing mechanism and program rules for the FiT program, the ReMAT, in response to stakeholders' petitions for modification.⁵⁷¹ The ReMAT allows the FiT price to adjust in real-time based on market conditions. ReMAT is being implemented by IOUs to comply with the IOU's portion of the 750 MW state-wide feed-in tariff program mandated by SB 32.⁵⁷² ReMAT includes two principle components: First, the starting price increases or decreases for each product type based on the market's participation in the

⁵⁶⁷ Institute for Self Reliance. *Expect Delays - Reviewing Ontario's "Buy Local" Renewable Energy Program*. May 2013.

⁵⁶⁸ Institute for Self Reliance. *Expect Delays - Reviewing Ontario's "Buy Local" Renewable Energy Program*. May 2013.

⁵⁶⁹ The National Association of Regulatory Utility Commissioners (NARUC). *Feed-in Tariffs: Frequently Asked Questions for State Utility Commissions*. June 2010. Report accessed August 2013 at <http://www.naruc.org/Publications/NARUC%20Feed%20in%20Tariff%20FAQ.pdf>

⁵⁷⁰ California Public Utilities Commission. *Feed-in Tariffs Legislative History*. Accessed August 2013 at: http://www.cpuc.ca.gov/PUC/energy/Renewables/hot/fit_legislativeHistory.htm

⁵⁷¹ WSGR. *California Public Utilities Commission Adopts Terms of Standard FIT Contract and Revised Tariffs*. June 2013. Article access August 2013 at <http://www.wsgr.com/WSGR/Display.aspx?SectionName=publications/PDFSearch/wsgralert-standard-FIT-contract.htm>

⁵⁷² http://www.pge.com/includes/docs/pdfs/b2b/energysupply/wholesaleelectricssuppliersolicitation/standardcontractsforpurchase/ReMAT_Webinar1_Overview.pdf

program and applies to three FiT product types (ie. baseload, peaking as-available, and non-peaking as-available). Second, a two-month price adjustment mechanism may increase or decrease the price for each product type every two months based on the market response. The IOU-share of MWs under the revised FiT program is 493.6 MW.⁵⁷³

16.2 GHG Impacts

Like any renewable power source, the GHG impacts from FiT programs depend largely on the source of power being replaced. Generally, specific quantification of GHG reduction benefits associated with FiT programs reviewed was not available. **Table 45** summarizes findings of available GHG-related information for select FiT programs.

Table 45: GHG Costs and Benefits of FiT Programs

Germany	
Cost of Reductions	Cost of reductions for solar in 2010 was €537 or (\$714)/mtCO₂e while the cost of reductions for wind in 2010 was €44 or (\$58.5)/ mtCO₂e. ⁵⁷⁴
Volume of Reductions	2010 reductions from solar was 7 million tCO ₂ e while the volume of reductions for wind in 2010 was 27 million tCO ₂ e. ⁵⁷⁵
Programmatic Status	The program has provided a strong market for German based manufactures and the country was a net exporter of renewable energy technologies and services.
Emissions Leakage	Data not readily available.
Ontario	
Cost of Reductions	Data not readily available.
Volume of Reductions	Data not readily available.
Programmatic Status	As of March 2013, OPA executed 1,706 micro, ⁵⁷⁶ small and large FIT contracts for 4,541 MW in renewable energy projects, with another 882 contracts for an additional 10,577 MW in the pipeline. ⁵⁷⁷
Emissions Leakage	Data not readily available.
California	
Cost of Reductions	2012 FiT rates range from \$0.77/kWh to \$0.93/kWh depending on the

⁵⁷³ WSGR. *California Public Utilities Commission Adopts Terms of Standard FIT Contract and Revised Tariffs*. June 2013.

⁵⁷⁴ Marcantonini and Ellerman. The Cost of Abating CO₂ Emissions by Renewable Energy Incentives in Germany. Accessed August 2013 at: http://cadmus.eui.eu/bitstream/handle/1814/25842/RSCAS_2013_05rev.pdf?sequence=1

⁵⁷⁵ Ibid.

⁵⁷⁶ Micro FIT applies to systems less than 10 kW, and is meant to encourage homeowners, farmers and small business owners to build more distributed energy systems, particularly wind and solar. It offers special incentives and assistance, including fast tracked applications, no connection test required, automatic contract eligibility and higher payments. "Feed-In Tariffs: Frequently Asked Questions for State Utility Commissions", NARUC, June 2010. <http://www.naruc.org/Publications/NARUC%20Feed%20in%20Tariff%20FAQ.pdf>

⁵⁷⁷ Power Authority FIT Program Website, "March 2013 Quarterly Program Report," June 24, 2013. Accessed August 2013. <http://fit.powerauthority.on.ca/fit-program>

	contract period ⁵⁷⁸
Volume of Reductions	Data not readily available.
Programmatic Status	Data not readily available.
Emissions Leakage	FiT is targeted to local generators in utility territories.

16.3 Energy and Economic Impacts

FiT programs increase renewable energy generation sources, create direct and indirect clean energy jobs, and attract private sector investment. For example, the German FiT program is extensive and, in conjunction with Germany's pledge to reduce GHG emissions by 40% by 2020, has significantly impacted the deployment and growth of renewable energy sources. In 2012, 12.6% of the total energy produced in Germany was generated from renewable energy sources as follows: Biomass (8.2%); Wind energy (1.8%), Photovoltaic (1.1%) Hydropower: 0.8% and Solar thermal and geothermal (0.5%).⁵⁷⁹ The renewable energy based electric energy supply had a total production of 136.1 TWH accounting for 22.9% of total electricity produced. The major sources are Wind (33.8%), Photovoltaic (20.6%); Hydropower (15.6%) and Biomass (30%).⁵⁸⁰

The Ontario program has taken special steps to encourage participation in certain sectors. To further municipal and public entity participation in new renewable installations, special incentives will be provided to eligible entities including municipalities, publicly funded schools, public colleges and universities, hospitals, publicly owned long term care homes, public transit services and Metrolinx (transportation authority). Special incentives will include a "price adder" to the standard FiT pricing, the provision of priority points during the application process, and the creation of capacity set-asides. In addition, municipalities and other public sector entities noted above will have access to funding for costs associated with design and development of the small FIT projects.⁵⁸¹

Table 46 summarizes the available energy and economic impact information for select FiT programs.

Table 46: Energy and Economic Impacts of FiT Programs

Germany	
Independence from Fossil	The program costs are passed on to rate payers as an EEG levy, which has

⁵⁷⁸ California Public Utilities Commission, <http://www.cpuc.ca.gov/PUC/energy/Renewables/Feed-in+Tariff+Price.htm> accessed 8/12/13

⁵⁷⁹ AGEE-Stat 2013, Renewable Energy Sources in Germany – Key information 2012 at a glance, Published by AGEE-Stat, February 2013. Accessed August 2013 at: http://www.bmu.de/fileadmin/bmu-import/files/english/pdf/application/pdf/ee_in_zahlen_tischvorlage_en.pdf

⁵⁸⁰ Ibid. - AGEE-Stat 2013

⁵⁸¹ Borden Ladner Gervais, "A New Path for Renewables: Major Changes to Ontario's Renewable Procurement and Feed-In Tariff (FIT) Program, *Martindale.com*, June 20, 2013. Accessed on August 12, 2013. http://www.martindale.com/energy-law/article_Borden-Ladner-Gervais-LLP_1846884.htm

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Fuels, and Economic Impact	resulted in high costs for electricity. Germany has the second highest power cost in the European Union. The average cost of electricity is €0.26/kWh and this represents a significant premium when compared to retail market prices for electricity. This issue has become a significant economic and political concern. ⁵⁸²
Impacts on Fuel Choice	Movement towards renewable power.
Opportunity for Investments in Infrastructure and Clean Energy/Energy Efficiency	The growth in renewable energy investments by 2016 is anticipated to be €23.7 Billion. ⁵⁸³ Germany leads the world in renewable energy investment, capturing 13 percent of global investment. ⁵⁸⁴
Impact on Different Sectors of the Economy	Renewable energy accounted for total investment of €22.9 Billion in 2011, with PVs accounting for €15.0 Billion. ⁵⁸⁵ The total economic output of German based renewable energy manufactures and installers in 2011 was €24.94 Billion, including exports. This sector supported 381,600 jobs. ⁵⁸⁶
Ontario	
Independence from Fossil Fuels, and Economic Impact	As of March 2013, OPA had executed 1,706 micro,⁵⁸⁷ small and large FIT contracts for 4,541 MW in renewable energy projects, with another 882 contracts for an additional 10,577 MW in the pipeline.
Impacts on Fuel Choice	Phasing out coal-fired electricity generation by 2014. ⁵⁸⁸ To prepare for the coal phaseout, the aggressive energy law in 2009 established energy efficiency programs and a feed-in tariff providing generous financial benefits to renewable developers. Those efficiency programs have helped make Ontario one of the few jurisdictions where energy demand is declining, rather than increasing. ⁵⁸⁹
Opportunity for Investments in Infrastructure and Clean Energy/Energy Efficiency	Over \$27 billion in private sector investment to Ontario. The program has created 20,000 jobs and is expected to create 50,000 jobs. ⁵⁹⁰
Impact on Different Sectors	The program has increased the amount of clean energy in Ontario's supply

⁵⁸² The growing cost of Germany's feed-in tariffs. Web Article from business spectator.com, Feb, 2013. Accessed Aug. 13, 2013. <http://www.businessspectator.com.au/article/2013/2/21/policy-politics/growing-cost-germanys-feed-tariffs>

⁵⁸³ The growing cost of Germany's feed-in tariffs. Web Article from business spectator.com, Feb, 2013. Accessed Aug. 13, 2013. <http://www.businessspectator.com.au/article/2013/2/21/policy-politics/growing-cost-germanys-feed-tariffs>

⁵⁸⁴ http://www.edf.org/sites/default/files/EU_ETS_Lessons_Learned_Report_EDF.pdf

⁵⁸⁵ Sullivan et al - RE investment estimate published in research report "Gross employment from renewable energy in Germany in 2011" by Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, March 14, 2012, Accessed August 13, 2013. http://www.erneuerbare-energien.de/fileadmin/ee-import/files/english/pdf/application/pdf/ee_bruttobeschaeftigung_en_bf.pdf

⁵⁸⁶ Ibid.

⁵⁸⁷ Micro FIT applies to systems less than 10 kW, and is meant to encourage homeowners, farmers and small business owners to build more distributed energy systems, particularly wind and solar. It offers special incentives and assistance, including fast tracked applications, no connection test required, automatic contract eligibility and higher payments. "Feed-In Tariffs: Frequently Asked Questions for State Utility Commissions", NARUC, June 2010.

⁵⁸⁸ Ontario's Feed-in Tariff Program Two-Year Review Report, Fareed Amin, Ontario Deputy Minister Of Energy, March 19, 2012. Accessed August 12, 2013. <http://www.energy.gov.on.ca/docs/en/FIT-Review-Report.pdf>

⁵⁸⁹ <http://www.scientificamerican.com/article.cfm?id=ontario-phases-out-coal-fired-power>

⁵⁹⁰ <http://www.energy.gov.on.ca/docs/en/FIT-Review-Report.pdf>

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of the Economy	mix, created over 20, 000 jobs, and attracted over \$20 billion in private sector investment to Ontario during challenging economic times. ⁵⁹¹
California	
Independence from Fossil Fuels, and Economic Impact	Data not readily available.
Impacts on Fuel Choice	Data not readily available.
Opportunity for Investments in Infrastructure and Clean Energy/Energy Efficiency	Projected \$50 billion in total new investment in CA ⁵⁹²
Impact on Different Sectors of the Economy	Projected 28,000 direct jobs per year, and 27,000 indirect jobs per year on average, and increase direct state revenue by \$1.7 billion. ⁵⁹³

Household Impacts and Co-Benefits

Table 47 highlights that little data on household impact and co-benefit information for FiT programs was readily available.

Table 47: Household Impacts and Co-Benefits of FiT Programs

Germany	
Effect on Household Consumption and Spending	<p>Germany FIT is regressive where higher income households stand to gain more than lower income households. However, this effect is small. The anticipated incremental levy is estimated to be €0.0353/kWh in 2011 to €0.0458/kWh in 2015. The increased levy will impact disposable income ranging from €21.06 for the lowest economic bracket with a monthly disposable income less than €500 to €50.10 for the highest bracket with a monthly disposable income in excess of €4,500.⁵⁹⁴</p> <p>Germany's feed-in tariff is likely to be regressive, i.e. redistributing income shares from the lower to the upper part of the income distribution. Poorer households spend a higher share of their income on electricity than wealthy households, and a levy raised proportionally to electricity consumption emphasizes this differential. Moreover, the collected</p>

⁵⁹¹ Ontario's Feed-in Tariff Program Two-Year Review Report, Fareed Amin, Ontario Deputy Minister Of Energy, March 19, 2012. Accessed August 12, 2013. <http://www.energy.gov.on.ca/docs/en/FIT-Review-Report.pdf>

⁵⁹² Wei, Max, Daniel Kammen. 2010. Economic Benefits of a Comprehensive Feed-In Tariff: An Analysis of the REESA in California. Renewable and Appropriate Energy Laboratory, University of California, Berkeley.

⁵⁹³ Ibid.

⁵⁹⁴ Grösche et al (2011), on the redistributive effects of Germany's Feed in Tariff, published by Department of Economics, Christian-Albrechts-Universiitat zu Keil. June 2011, Accessed August 14, 2013. <http://www.econstor.eu/bitstream/10419/49291/1/66579133X.pdf>

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	revenues are used for subsidizing renewable energy installations, investments typically undertaken by wealthier households. ⁵⁹⁵
Measures to Mitigate to Low-income Populations, or Economic Impact	Data not readily available.
Significant Co-benefits	The program provides flexibility and accommodates a wide variety of technologies, and encourages small and large producers to participate. The program is geographically neutral, which encourages project development and is also promoted as a local economic stimulus program.
Ontario	
Effect on Household Consumption and Spending	Data not readily available.
Measures to Mitigate to Low-income Populations, or Economic Impact	Priority consideration, project design/development funding, and “price adders” are given to projects that have a minimum of 15% participation level from Community or Aboriginal groups. ⁵⁹⁶
Significant Co-benefits	The program has increased the amount of clean energy in Ontario’s supply mix, created thousands of direct and indirect clean energy jobs, and attracted over \$20 billion in private sector investment to Ontario during challenging economic times. ⁵⁹⁷
California	
Effect on Household Consumption and Spending	Data not readily available.
Measures to Mitigate to Low-income Populations, or Economic Impact	Data not readily available.
Any significant co-benefits to the jurisdiction	Data not readily available.

⁵⁹⁵ Grösche et al (2011), on the redistributive effects of Germany’s Feed in Tariff, published by Department of Economics, Christian-Albrechts-Universität zu Kiel. June 2011, Accessed August 14, 2013. <http://www.econstor.eu/bitstream/10419/49291/1/66579133X.pdf>

⁵⁹⁶ Ibid. Program Overview

⁵⁹⁷ Ontario Power Authority FIT Program Website, “March 2013 Quarterly Program Report,” June 24, 2013. Accessed August 12, 2013. <http://fit.powerauthority.on.ca/fit-program>

17 Shore Power

Policy Definition	Targeted Sector or Emissions
Shore power, also known as port electrification or cold ironing, is the process of transferring the electrical generation needs for Ocean Going Vessels (OGV) while at berth (docked) from onboard diesel auxiliary engines to cleaner shore-side power grids.	Transportation
GHGs and Costs	
California saw 2,400 mtCO ₂ e reduction in 2011, with an expected 200,000 mtCO ₂ e reduction in 2020. Canada saw 1,521 mt CO ₂ e reduction from April to October 2010.	
Implementation Issues and Lessons Learned	
<ul style="list-style-type: none"> • The shore power approach is generally best suited for vessels that make multiple calls at the same terminal for multiple years. • The best candidates for shore power are large container ships, cruise ships, reefer (refrigerated) ships, and specially-designed crude tankers that have diesel-electric engines. • Shore power requires extensive infrastructure improvements both on the terminal side for supplying the appropriate level of conditioned electrical power and on-board the vessels that will use the system.⁵⁹⁸ 	
Costs and Benefits to Consumers	Costs and Benefits to Businesses
<ul style="list-style-type: none"> • No consumer costs from shore power projects have been identified • Improved air quality through reduction in emissions rates. 	<ul style="list-style-type: none"> • Increased costs for vessel construction or retrofit • Increased competitiveness as more global ports equip vessels with shore power capabilities • Reduced energy costs while vessels call at port • Shore power infrastructure requires investment from ports and companies to design, build, and install shore power technology both on land and vessels. These projects represent opportunities for engineering and construction jobs within the State of Washington • Shipping companies will see a reduction in costs associated with reduced fuel consumption • Shore power at ports in Washington has the potential to increase the demand on local jurisdictions' electric power supply

Shore power, also known as port electrification or cold ironing, is the process of transferring the electrical generation needs for Ocean Going Vessels (OGV) while at berth (docked) from onboard diesel auxiliary engines to cleaner shore-side power grids.

The fuel use and emissions from maritime port sources can be significant, with OGVs and harbor craft being major contributors to air pollution and GHG emissions in and around ports. For example, a 2004 study showed that the Port of Los Angeles alone released average daily air pollution and GHG emissions exceeding that of 500,000 vehicles. A 2013 Sandia National

⁵⁹⁸ San Pedro Bay Ports Clean Air Action Plan 2010 Update. (October 2010). Pages 89-90. Access August 2013 at: <http://www.cleanairactionplan.org/civica/filebank/blobdload.asp?BlobID=2485>

Laboratories report on vessel cold-ironing states that “approximately one-third to one-half of emissions attributed to OGVs come from their auxiliary diesel engines, which are run while the vessel is at berth and require electrical power for everything from lighting to loading and discharging equipment.” Reducing the use of diesel auxiliary engines while OGVs are at port reduces GHG emissions and improves air quality by reducing emissions of particulate matter and nitrogen oxides (NO_x).⁵⁹⁹ The Puget Sound Clean Air Agency (PSCAA) calculates that just eight hours of shore power cuts on-board oil burning by 2.85 metric tons of fuel. Although the Electrify Transportation in Washington report does not give specific reductions estimates, air emissions are reported to be reduced by about 30 percent per eight-hour port call for cruise ships.⁶⁰⁰

The shore power approach is generally best suited for vessels that make multiple calls at the same terminal for multiple years. The best candidates for shore power are large container ships, cruise ships, reefer (refrigerated) ships, and specially-designed crude tankers that have diesel-electric engines. Shore power requires extensive infrastructure improvements both on the terminal side for supplying the appropriate level of conditioned electrical power and on-board the vessels that will use the system.⁶⁰¹

California and Canada (primarily British Columbia) have implemented shore power regulation and initiatives, respectively. Washington ports have facilitated private sector infrastructure investments to implement shore power for a cruise terminal at the Port of Seattle and a container ship terminal at the Port of Tacoma. As shore power technology is adopted more broadly at all West Coast ports, shore power will become more feasible for container and cargo ships that call at Washington ports.⁶⁰² No federal standards or control requirements have been promulgated addressing emission reductions from at-berth OGV auxiliary engines.⁶⁰³

17.1 Existing Policies

This section summarizes shore power programs implemented in other jurisdictions. The following programs are included:

⁵⁹⁹ Pratt and Harris. 2013. Vessel Cold-Ironing Using a Barge Mounted PEM Fuel Cell: Project Scoping and Feasibility. (February 2013). Page 5. Accessed August 2013 at:

http://www1.eere.energy.gov/hydrogenandfuelcells/pdfs/sand2013-0501_barge_mounted_pemfc.pdf

⁶⁰⁰ Electrify Transportation in Washington. 2007. Electrify Transportation Briefing Book. (January 2007.) Page 16.

Accessed August 2013 at: http://www.plugincenter.net/wp-content/uploads/2010/10/Electrify_Transportation_Briefing_Book.pdf

⁶⁰¹ San Pedro Bay Ports Clean Air Action Plan 2010 Update. (October 2010). Pages 89-90. Access August 2013 at: <http://www.cleanairactionplan.org/civica/filebank/blobdload.asp?BlobID=2485>

⁶⁰² Electrify Transportation in Washington. 2007. Electrify Transportation Briefing Book. (January 2007.) Page 16. Accessed August 2013 at: http://www.plugincenter.net/wp-content/uploads/2010/10/Electrify_Transportation_Briefing_Book.pdf

⁶⁰³ California Air Resources Board (CARB). Adoption of the Regulation to Reduce Emissions from Diesel Auxiliary Engines on Ocean-going Vessels While at Berth. (October 18, 2008). Accessed August 2013 at: <http://www.arb.ca.gov/regact/2007/shorepwr07/uid2007.pdf>

The California Air Resources Board At-Berth Regulation: In December 2007, the California Air Resources Board (ARB) approved the “Airborne Toxic Control Measure for Auxiliary Diesel Engines Operated on Ocean-Going Vessels At-Berth in a California Port” Regulation, commonly referred to as the At-Berth Regulation. The purpose of the At-Berth Regulation is to reduce diesel particulate matter (DPM) and NO_x emissions from diesel auxiliary engines on container ships, passenger ships, and refrigerated-cargo ships while berthing at California Ports. California Ports include the Port of Los Angeles (POLA), Long Beach (POLB), Oakland, San Diego, San Francisco, and Hueneme. The most common method for complying with the At-Berth Regulation is expected to be plugging in to shore power.⁶⁰⁴

The At-Berth Regulation requires a fleet to satisfy auxiliary engine operating limits for a percentage of visits, reduce the percentage of power produced by auxiliary engines in the fleet while at berth, and utilize available shore power if a vessel is equipped with shore power capabilities. OGV fleets are required to achieve compliance on January 1, 2014. The regulation requires 50 percent shore power usage and 50 percent reduction of auxiliary engine power during a fleet’s quarterly visits to a port by 2014, 70 percent by 2017, and 80 percent by 2020.⁶⁰⁵

During 2006 through 2009, the POLA and POLB invested a combined \$52.1 million to implement shore power programs. The Ports implemented the programs alongside the ARB regulation and expect to have shore power implemented at all major container and cruise terminals and one liquid bulk terminal at the POLA, and at all container terminals, one crude oil terminal, and one liquid bulk terminal at the POLB by 2014. The POLA and POLB expect the use of shore power at berth will reduce OGV emissions of CO₂ by 95 percent per vessel call. The estimate does not account for power plant emissions. The Ports intend to largely recapture the infrastructure costs over time through financial terms in the leases with terminal tenants.⁶⁰⁶

In May 2011, the South Coast Air Quality Management District awarded \$58 million dollars from voter approved Proposition 1B for funding of 25 shore power infrastructure projects that will greatly reduce diesel emissions from ships calling at the POLA, POLB, and Port of Hueneme. The award helped fund the projects to accommodate the expected growth in electrified ships visiting the ports because of the CARB’s At-Berth Regulation. The shore power projects will be completed at the end of 2013 and are estimated to reduce annual emissions of 762 tons of NO_x and 13 tons of DPM over 10 years.⁶⁰⁷

⁶⁰⁴ CARB. Shore Power for Ocean-going Vessels, Background. Accessed August 2013 at: <http://www.arb.ca.gov/ports/shorepower/background/background.htm>

⁶⁰⁵ CARB. Shore Power for Ocean-going Vessels, FAQs. (February 11, 2013). Accessed August 2013 at: <http://www.arb.ca.gov/ports/shorepower/faq/faq.htm#>

⁶⁰⁶ San Pedro Bay Ports Clean Air Action Plan 2010 Update. (October 2010). Access August 2013 at: <http://www.cleanairactionplan.org/civica/filebank/blobdload.asp?BlobID=2485>

⁶⁰⁷ South Coast Air Quality Management District. AQMD Awards Nearly \$60 Million for Ship Electrification, Shore-Side Power Projects. (May 2011). Accessed August 2013 at: <http://www.aqmd.gov/news1/2011/bs050611.htm>

The Port of San Francisco became the first California port to provide shore power for cruise ships while at berth in October 2010. The project budget was \$5.2 million and was funded through contributions from multiple agencies including the Bay Area Air Quality Management District (\$1.9 million), San Francisco Public Utilities Commission (\$1.3 million), U.S. EPA Diesel Emission Reduction Act Program (\$1.0 million), and the Port of San Francisco (\$1.0 million). The Port of San Francisco estimates that the reductions in emissions for a 10-hour ship call are approximately 140 pounds of DPM, 1.3 tons of NO_x, 0.87 tons of sulfur oxides (SO_x), and 19.7 mtCO₂e.⁶⁰⁸ Although there is no data on how often the ships use the shore power at this port, container and reefer ships must comply with California's at-berth regulations if they dock at a port 25 or more times annually while passenger ships must comply if they visit a port 5 or more times per year.⁶⁰⁹ Consequently, vessels using this shore power will be making multiple trips to the port.

Transport Canada Marine Shore Power and Shore Power Technology for Ports Programs:

Transport Canada, the country's department responsible for developing regulations, policies, and services of transportation, completed the Marine Shore Power Program between 2007 and 2012. The program provided \$2 million (CAD) to Port Metro Vancouver to install shore power technology for cruise ships and \$1.8 million (CAD) to the Port of Prince Rupert to support installation of shore power for container ships.⁶¹⁰ As part of the Marine Shore Power Program, The Port Metro Vancouver became the first port in Canada and third in the world to install shore power for cruise ships. This 2009 installation for cruise ships represents a \$9 million (CAD) initiative by the Government of Canada, the British Columbia Ministry of Transportation and Infrastructure, Holland America Line, Princess Cruises, BC Hydro and Port Metro Vancouver. Between April and October 2010, Port Metro Vancouver completed 44 shore power connections, which reduced GHG emissions by 1,521 mtCO₂e. Based on costs at the time of measurement, cruise ships saved an average of \$234 (CAD) and 1.78 metric tons of fuel each hour that their engine was shut off while at berth.⁶¹¹ In 2011, 35 vessels connected to the Ports shore power facilities, reducing GHG emissions by 1,318 mtCO₂e.⁶¹²

In January 2012, the Government of Canada approved a \$27.2 million (CAD) Shore Power Technology for Ports Program as part of the country's Clean Air Agenda. The Clean Air Agenda

⁶⁰⁸ Office of the Mayor, City & County of San Francisco. Mayor Newsom and the Port of San Francisco Inaugurate Cruise Ship Using Shoreside Power. (October 2010). Accessed August 2013 at:

<http://www.epa.gov/region9/mediacenter/posf-dera/SF-Port-Shore-Power.pdf>

⁶⁰⁹ California Air Resources Board. 2012. At-berth Regulation Presentation. Accessed September 2013 online at:

<http://www.arb.ca.gov/ports/shorepower/meetings/10032012/presentation.pdf>

⁶¹⁰ Transport Canada. Harper government invests in Canadian ports. (January 25, 2012). Accessed August 2013 at:

<http://www.tc.gc.ca/eng/mediaroom/release-2012-h004e-6622.htm>

⁶¹¹ Transport Canada. Case Study – Port Metro Vancouver Shore Power Project. (February 2, 2012). Accessed

August 2013 at: <http://www.tc.gc.ca/eng/programs/environment-sptp-case-study-2690.htm>

⁶¹² Port Metro Vancouver. Shore Power at Canada Place. Access August 2013 at:

<http://www.portmetrovanancouver.com/en/about/cruiseandtourism/shorepower.aspx>

funds initiatives with an economy-wide target of reducing GHG emissions by 17 percent from 2005 levels by 2020. As part of the program, Seaspan Ferries Corporation will be installing shore power at the Swartz Bay Ferry Terminal in 2013. The project will cost \$179,300 (CAD) and will decrease fuel consumption at the Swartz Bay Ferry Terminal by approximately 70,000 litres (18,500 gallons) annually, representing a net savings of about \$45,000 (CAD) and an approximate 210 mtCO₂e reduction in GHG emissions.⁶¹³ Beginning in 2014, the Port of Halifax will be the first port in Atlantic Canada to implement shore power for cruise ships. The shore power infrastructure project represents a \$10 million (CAD) initiative among the Government of Canada, the Province of Nova Scotia, and the Port of Halifax. Once installed, the shore power operation will decrease cruise ship idling by seven percent, representing an annual decrease of approximately 123,000 litres (32,500 gallons) of fuel usage and 370 mtCO₂e of GHG and air pollutant emissions.⁶¹⁴

Shore Power Projects in Washington State: The Port of Seattle, Princess Cruises, and Holland America Line completed a \$7.5 million shore power project at Seattle's Terminal 30 in 2005 and 2006. The cruise lines each contributed approximately \$1.5-1.7 million on landside infrastructure and \$1.0-1.1 million for retrofitting five vessels (two Princess Cruise vessels and three Holland America Line vessels). The USEPA and Puget Sound Clean Air Agency provided \$75,000 in grant funding to assist the projects. Participating vessels are cutting annual CO₂ emissions by up to 29 percent annually, with financial savings on energy costs of up to 26 percent per call.⁶¹⁵ The cruise lines' shore power systems were relocated to Terminal 91 in 2009.⁶¹⁶

In October 2010, a \$2.7 million shore power project was completed at the Port of Tacoma's Totem Ocean Trailer Express, Inc. (TOTE) terminal. The U.S. EPA awarded the Port of Tacoma a \$1.5 million grant to construct a shore side connection and power system at the terminal. TOTE contributed approximately \$1.2 million to retrofit two Alaska trade ships that make weekly calls at the terminal. The shore power project estimated a reduction of diesel and GHG emissions by up to 90 percent during TOTE's 100 annual ship calls. That translates to about 1.9 tons of diesel particulates and 1,360 mtCO₂e each year. The infrastructure update sustained an estimated 50 manufacturing and local installation jobs.⁶¹⁷

⁶¹³ Transport Canada. Shore power arrives at Swartz Bay Ferry Terminal. (March 6, 2013). Accessed August 2013 at: <http://www.tc.gc.ca/eng/mediaroom/releases-2013-h024e-7068.htm>

⁶¹⁴ Transport Canada. Shore power arrives at the Port of Halifax. (January 23, 2013). Accessed August 2013 at: <http://www.tc.gc.ca/eng/mediaroom/releases-2013-h003e-7035.htm>

⁶¹⁵ 40 Cities. Port of Seattle Cuts Vessel Emissions by 29% Annually and Saves 26% on Energy Costs per Call. Access August 2013 at: http://www.c40cities.org/c40cities/seattle/city_case_studies/port-of-seattle-cuts-vessel-emissions-by-29-annually-and-saves-26-on-energy-costs-per-call

⁶¹⁶ Cochran Marine. Seattle – Terminal 91 Shore Power Relocation. Accessed August 2013 at: <http://www.cochranmarine.com/current-installations/seattle-shore-power-relocation-terminal-91/>

⁶¹⁷ Port of Tacoma. First cargo ship in Pacific Northwest plugs into shore power at Port of Tacoma. (October 27, 2010). Accessed August 2013 at: <http://www.portoftacoma.com/Page.aspx?cid=4773>

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The following sections present results for shore power projects at ports in California and Canada. The programs highlight collaborative efforts between federal, state, and local agencies with private industry to implement shore power infrastructure and vessel retrofits to reduce GHG emissions and improve air quality. In addition, economic impacts from the use of shore power for container ships, cruise ships, or ferry vessels in these jurisdictions are directly applicable to ports in the Puget Sound Region. As a result, these programs were deemed most appropriate for use by Washington.

17.2 GHG Impacts

Table 48 summarizes the available GHG-related information for the California and British Columbia programs. Implementation of California's At-Berth Regulation is estimated to reduce emissions from OGVs by 80 percent in 2020,⁶¹⁸ and POLA and POLB GHG emissions from OGVs will be reduced by 95 percent.⁶¹⁹ The Marine Shore Power Program adopted at Canada Place Terminal in Vancouver, British Columbia has proven to be a reliable and effective solution to reduce large-scale emissions and has been expanded to other ports in Canada in recent years.⁶²⁰

Table 48: GHG Costs and Benefits of Example Shore Power Programs

California	
Cost of Reductions	None noted.
Volume of Reductions	2,400 mtCO₂e (in 2011) 200,000 mtCO₂e (2020) ⁶²¹
Programmatic Status	The program is in the early stages of implementation. Successes of the program will be realized over time. A better assessment can be made following the At-Berth Regulation requirement of 50 percent reduction in emissions per fleet by 2014. ⁶²²
Emissions Leakage	Displacement of emissions from OGVs auxiliary engines to electric power plants. Source of electricity generation at power plants will determine overall emissions reductions. ⁶²³
Canada	

⁶¹⁸ Transport Canada. Case Study – Port Metro Vancouver Shore Power Project. (February 2, 2012). Accessed August 2013 at: <http://www.tc.gc.ca/eng/programs/environment-sptp-case-study-2690.htm>

⁶¹⁹ Port of Long Beach and Port of Los Angeles. San Pedro Bay Ports Clean Air Action Plan 2010 Update. (October 2010). Pages 89-90. Accessed August 2013 at: <http://www.cleanairactionplan.org/civica/filebank/blobdload.asp?BlobID=2485>

⁶²⁰ Transport Canada. Case Study – Port Metro Vancouver Shore Power Project. (February 2, 2012). Accessed August 2013 at: <http://www.tc.gc.ca/eng/programs/environment-sptp-case-study-2690.htm>

⁶²¹ California Climate Change Portal. 2013. January 2013 State Agency Greenhouse Gas Reduction Report Card. (January 2013). Pages 2 and Table 2 page 3. Accessed August 2013 at: http://www.climatechange.ca.gov/climate_action_team/reports/2013_CalEPA_Report_Card.pdf

⁶²² CARB. Shore Power for Ocean-going Vessels, Background. Accessed August 2013 at: <http://www.arb.ca.gov/ports/shorepower/background/background.htm>

⁶²³ Pratt and Harris. 2013. Vessel Cold-Ironing Using a Barge Mounted PEM Fuel Cell: Project Scoping and Feasibility. (February 2013). Page 16. Accessed August 2013 at: http://www1.eere.energy.gov/hydrogenandfuelcells/pdfs/sand2013-0501_barge_mounted_pemfc.pdf

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Cost of Reductions	None noted.
Volume of Reductions	1,521 mtCO₂e (April 2010 to October 2010 at Canada Place Terminal) ⁶²⁴
Programmatic Status	The Marine Shore Power Program was deemed a success from 2007 to 2012. The Shore Power for Ports Program was passed in 2012 and will build on past successes.
Emissions Leakage	Displacement of emissions from OGVs back to electric power plants. Source of electricity generation at power plants will determine overall emissions reductions. ⁶²⁵

17.3 Energy and Economic Impacts

Table 49 summarizes the available energy and economic impact information for the California and Canadian shore power programs. The POLA and POLB are examples of significant economic investments for shore power infrastructure. Infrastructure development includes jobs for terminal improvements, engineering services, permitting, and construction management. Ports with shore power capabilities will continue to be competitive economic hubs. For example, the Port of Halifax generated approximately \$1.5 billion economic growth and contributed over 11,000 port-related jobs in 2012.⁶²⁶

Table 49: Energy and Economic Impacts of Example Shore Power Programs

California	
Independence from Fossil Fuels, and Economic Impact	Independence from fossil fuels will be increased through reduction in diesel fuel consumption to power OGVs while at port. ⁶²⁷
Impacts on Fuel Choice	Increase in demand on local jurisdictions electricity power supply. ⁶²⁸

⁶²⁴ Transport Canada. Case Study – Port Metro Vancouver Shore Power Project. (February 2, 2012). Accessed August 2013 at: <http://www.tc.gc.ca/eng/programs/environment-sptp-case-study-2690.htm>

⁶²⁵ Pratt and Harris. 2013. Vessel Cold-Ironing Using a Barge Mounted PEM Fuel Cell: Project Scoping and Feasibility. (February 2013). Page 16. Accessed August 2013 at: http://www1.eere.energy.gov/hydrogenandfuelcells/pdfs/sand2013-0501_barge_mounted_pemfc.pdf

⁶²⁶ Transport Canada. Shore power arrives at the Port of Halifax. (January 23, 2013). Accessed August 2013 at: <http://www.tc.gc.ca/eng/mediaroom/releases-2013-h003e-7035.htm>

⁶²⁷ Pratt and Harris. 2013. Vessel Cold-Ironing Using a Barge Mounted PEM Fuel Cell: Project Scoping and Feasibility. (February 2013). Page 16. Accessed August 2013 at: http://www1.eere.energy.gov/hydrogenandfuelcells/pdfs/sand2013-0501_barge_mounted_pemfc.pdf

⁶²⁸ Pratt and Harris. 2013. Vessel Cold-Ironing Using a Barge Mounted PEM Fuel Cell: Project Scoping and Feasibility. (February 2013). Page 16. Accessed August 2013 at: http://www1.eere.energy.gov/hydrogenandfuelcells/pdfs/sand2013-0501_barge_mounted_pemfc.pdf

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Opportunity for Investments in Infrastructure and Clean Energy/Energy Efficiency	Shore power requires extensive infrastructure improvements on-board vessels that would use the system, as well as on the terminal side for supplying appropriate levels of conditioned electrical power. ⁶²⁹ From 2006 to 2009, POLA and POLB invested \$52.1 million ⁶³⁰ , and in 2011 SCAQMD awarded \$58 million to fund shore power infrastructure. ⁶³¹ A Port of San Francisco project was budgeted at \$5.2 million. ⁶³²
Impact on Different Sectors of the Economy	Increased competitiveness as more fleets fit vessels with shore power capabilities. ⁶³³
Canada	
Independence from Fossil Fuels, and Economic Impact	Independence from fossil fuels will be increased through reduction in diesel fuel consumption to power OGVs while at port. Fuel savings of 146,000 gallons at Canada Place Terminal from April 2010 to October 2010. ⁶³⁴
Impacts on Fuel Choice	Increase in demand on local jurisdictions electricity power supply. ⁶³⁵
Opportunity for Investments in Infrastructure and Clean Energy/Energy Efficiency	Shore power requires extensive infrastructure improvements on-board vessels that would use the system, as well as on the terminal side for supplying appropriate levels of conditioned electrical power. ⁶³⁶ Swartz Bay Ferry Terminal Investment - \$179,300 (CAD) Canada Place Cruise Terminal Investment - \$9.4 million (CAD) Port of Halifax Cruise Terminal Investment - \$10 million (CAD)
Impact on Different Sectors of the Economy	Increased competitiveness as more fleets fit vessels with shore power capabilities.

17.4 Household Impacts and Co-Benefits

Table 50 summarizes the available household impacts and co-benefit information for the California and Canadian programs. Both programs will reduce GHG emissions as well as DPM,

⁶²⁹ Pratt and Harris. 2013. Vessel Cold-Ironing Using a Barge Mounted PEM Fuel Cell: Project Scoping and Feasibility. (February 2013). Page 16. Accessed August 2013 at:

http://www1.eere.energy.gov/hydrogenandfuelcells/pdfs/sand2013-0501_barge_mounted_pemfc.pdf

⁶³⁰ San Pedro Bay Ports Clean Air Action Plan 2010 Update. (October 2010). Access August 2013 at:

<http://www.cleanairactionplan.org/civica/filebank/blobdload.asp?BlobID=2485>

⁶³¹ South Coast Air Quality Management District. AQMD Awards Nearly \$60 Million for Ship Electrification, Shore-Side Power Projects. (May 2011). Accessed August 2013 at:

<http://www.aqmd.gov/news1/2011/bs050611.htm>

⁶³² Office of the Mayor, City & County of San Francisco. Mayor Newsom and the Port of San Francisco Inaugurate Cruise Ship Using Shoreside Power. (October 2010). Accessed August 2013 at:

<http://www.epa.gov/region9/mediacenter/posf-dera/SF-Port-Shore-Power.pdf>

⁶³³ San Pedro Bay Ports Clean Air Action Plan 2010 Update. (October 2010). Pages 89-90. Access August 2013 at:

<http://www.cleanairactionplan.org/civica/filebank/blobdload.asp?BlobID=2485>

⁶³⁴ Transport Canada. Case Study – Port Metro Vancouver Shore Power Project. (February 2, 2012). Accessed August 2013 at:

<http://www.tc.gc.ca/eng/programs/environment-sptp-case-study-2690.htm>

⁶³⁵ Pratt and Harris. 2013. Vessel Cold-Ironing Using a Barge Mounted PEM Fuel Cell: Project Scoping and Feasibility. (February 2013). Page 16. Accessed August 2013 at:

http://www1.eere.energy.gov/hydrogenandfuelcells/pdfs/sand2013-0501_barge_mounted_pemfc.pdf

⁶³⁶ Pratt and Harris. 2013. Vessel Cold-Ironing Using a Barge Mounted PEM Fuel Cell: Project Scoping and Feasibility. (February 2013). Page 16. Accessed August 2013 at:

http://www1.eere.energy.gov/hydrogenandfuelcells/pdfs/sand2013-0501_barge_mounted_pemfc.pdf

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NO_x, and SO_x to improve air quality in the surrounding area. Significant diesel emissions reductions from electric shore power connection will result in fewer incidences of asthma, cardiopulmonary diseases, lost school and work days, and premature deaths directly linked to diesel pollution.⁶³⁷ The programs are not expected to impact energy costs or costs of goods for households or low-income populations.

Table 50: Household Impacts and Co-Benefits of Example Shore Power Programs

California	
Effect on Household Consumption and Spending	Drawbacks to the program may include increased power consumption from local power grid causing energy costs to increase.
Measures to Mitigate to Low-income Populations, or Economic Impact	None noted.
Significant Co-benefits	Use of shore power will reduce OGV at-berth emissions of DPM, NO _x , and SO _x by 95 percent per vessel at POLA and POLB. ⁶³⁸ Expected increased health benefits from improved air quality. ⁶³⁹
Canada	
Effect on Household Consumption and Spending	None noted.
Measures to Mitigate to Low-income Populations, or Economic Impact	None noted.
Significant Co-benefits	Improved air quality through reduction in diesel auxiliary engines.

18 Landfill Methane Capture

Policy Definition	Targeted Sector or Emissions
A requirement that landfills with more than 450 thousand tons of waste-in-place install and operate landfill gas collection and control systems. These systems collect and destroy methane gas, and can be	Landfill methane

⁶³⁷ Office of the Mayor, City & County of San Francisco. Mayor Newsom and the Port of San Francisco Inaugurate Cruise Ship Using Shoreside Power. (October 2010). Accessed August 2013 at: <http://www.epa.gov/region9/mediacenter/posf-dera/SF-Port-Shore-Power.pdf>

⁶³⁸ San Pedro Bay Ports Clean Air Action Plan 2010 Update. (October 2010). Pages 89-90. Access August 2013 at: <http://www.cleanairactionplan.org/civica/filebank/blobdload.asp?BlobID=2485>

⁶³⁹ Office of the Mayor, City & County of San Francisco. Mayor Newsom and the Port of San Francisco Inaugurate Cruise Ship Using Shoreside Power. (October 2010). Accessed August 2013 at: <http://www.epa.gov/region9/mediacenter/posf-dera/SF-Port-Shore-Power.pdf>

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used to generate thermal or electric energy.	
GHGs and Costs	
<ul style="list-style-type: none"> Estimated by California ARB to cost from \$5.50 per mtCO₂e to a high of \$11.38 per mtCO₂e over the measure's expected life of 2010-2033, with an average of \$8.64 per mtCO₂e. Annual reductions of 1.2 MMTCO₂e in 2010 to an 2.1 MMTCO₂e in 2033. Cumulative 2010-2033 emission reductions are estimated at 38.8 MMTCO₂e. Regulatory costs are estimated to range from \$25,000-\$1.2 million annually. 	
Implementation Issues and Lessons Learned	
<ul style="list-style-type: none"> Relatively small source of GHG emissions in Washington, but achievable at a low cost per mtCO₂e. Must be coordinated with the federal New Source Performance Standards (NSPS) which regulates gassy landfills larger than 2.5 million metric tons design capacity. 	
Costs and Benefits to Consumers	Costs and Benefits to Businesses
<ul style="list-style-type: none"> \$0.09 per month per Californian Reduction in NMOC emissions 	<ul style="list-style-type: none"> Estimated capital investment of over \$27 million to design, construct, and install required landfill GCCS, and an additional \$6.4-\$14 million annually in recurring costs. Total costs for technology, operation, monitoring and maintenance are estimated at approximately \$335 million. Costs to landfill operators may translate into jobs in related sectors.

The anaerobic degradation of organic waste creates methane (CH₄), a potent GHG that is 21 times more heat trapping than carbon dioxide. Modern municipal solid waste (MSW) landfills are managed anaerobically (in the absence of oxygen), and emit CH₄ emissions over time, in varying amounts depending on landfill management practices. Typically, CH₄ comprises approximately 50 percent of landfill gas (LFG). In the U.S., landfills account for 17.5 percent of all CH₄ emissions, or about 1.8 percent of total GHG emissions.⁶⁴⁰

Federally, the New Source Performance Standard (NSPS) regulates large MSW landfills, and requires those with greater than 50 megagrams (Mg) emissions per year of non-methane organic compounds (NMOC) to install gas collection and control systems (GCCS). Although these systems are implemented for the management of NMOC, the management practice of combusting LFG also destroys the CH₄ component of the gas. Landfill GCCS capture and combust CH₄ generated at landfills, preventing it from being released to the atmosphere, or capture it for energy use if it is generated in large enough amounts.

The NSPS applies only to landfills with a design capacity of 2.5 million metric tons or greater.⁶⁴¹ However, many landfills in the U.S. are smaller than this, and there is no federal standard requiring GCCS at those sites. California implemented a Landfill Methane Control Measure as

⁶⁴⁰ U.S. Environmental Protection Agency. *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2011*. April 12, 2013. Accessed August 2013 at: <http://epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2013-Main-Text.pdf>

⁶⁴¹ U.S. Environmental Protection Agency. *Rule and Implementation Information for Standards of Performance for Municipal Solid Waste Landfills*. Accessed July 2013 at: <http://www.epa.gov/ttnatw01/landfill/landflpg.html>

part of their AB 32 Global Warming Solutions Act to target smaller landfills that still have significant CH₄ emissions.

18.1 Existing Policies

This section analyzes existing policies implemented in other jurisdictions which target landfill methane emissions. The following programs are included:

California Landfill Methane Control Measure: Under California regulation, landfills with greater than 450,000 tons of waste-in-place, a landfill gas heat rate greater than or equal to 3.0 MMBtu per hour, and which received waste after January 1, 1977 must install and operate a landfill GCCS with 99 percent destruction removal efficiency for methane. Hazardous waste landfills, construction and demolition landfills, and landfills regulated under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) are exempt.⁶⁴²

18.2 GHG Impacts

At this time, California is the only state in the U.S. that has implemented a landfill methane policy more stringent than the federal rules, and program evaluation data on emissions reductions and costs are unavailable. Table 51 summarizes the costs and reductions from the California program, as presented in the ARB Staff Initial Statement of Reasons.

Table 51: GHG Costs and Benefits of the CA Landfill Methane Control Measure

California	
Cost of Reductions	California ARB estimated total costs of implementation from 2010-2033 at \$111 million (2008 USD). The overall cost-effectiveness estimates inclusive of private and public costs of the measure range from a low of \$5.50 per mtCO₂e to a high of \$11.38 per mtCO₂e over the measure's expected life of 2010-2033, with an average of \$8.64 per mtCO ₂ e. ⁶⁴³
Volume of Reductions	Annual emission reductions range from a low of 1.2 MMTCO₂e in 2010 to an estimated high of 2.1 MMTCO₂e in 2033 . California ARB estimated that cumulative 2010-2033 emission reductions resulting from the measure would be 38,830,509 mtCO ₂ e. ⁶⁴⁴
Programmatic Status	There are currently no data available on the success of the program.
Emissions Leakage	There is no anticipated displacement or leakage of emission sources.

⁶⁴² California Air Resources Board. *Implementation Guidance Document for the Regulation to Reduce Methane Emissions from Municipal Solid Waste Landfills*. July 2011. Accessed August 2013 at: <http://www.arb.ca.gov/cc/landfills/docs/guidance0711.pdf>

⁶⁴³ California Air Resources Board. *Staff Report: Initial Statement of Reasons for the Proposed Regulation to Reduce Methane Emissions from Municipal Solid Waste Landfills*. May 2009. Accessed August 2013 at: <http://www.arb.ca.gov/regact/2009/landfills09/isor.pdf>

⁶⁴⁴ California Air Resources Board. May 2009.

In general, the Landfill Methane Control Measure represents a relatively low cost means of reducing CH₄ emissions according to California modeling. However, several parties commented during the public comment period that the ARB estimates were lower than many individual landfills would experience. For smaller landfills, the costs to mitigate CH₄ will be greater on a per mtCO₂e basis.

18.3 Energy and Economic Impacts

During policy development, the California ARB quantified costs and benefits of the Landfill Methane Control Measure for two sectors of the economy: landfill operators and regulators. As shown in Table 52, the total costs to affected businesses are approximately \$111 million. These costs include site monitoring, system installation, operation and maintenance, and reporting, much of which must be conducted on-site or in-state. The annual costs to the government for implementation and compliance monitoring is estimated to range from \$24,500 to \$1.2 million.⁶⁴⁵

Table 52: Energy and Economic Impacts of the CA Landfill Methane Control Measure

California	
Independence from Fossil Fuels, and Economic Impact	Landfill gas can be converted for use in vehicles as liquefied natural gas (LNG), or upgraded to pipeline quality methane. Additionally, if sufficient gas quantities exist the methane can be combusted for electricity generation. Any of these applications has the potential to displace fossil fuel.
Impacts on Fuel Choice	Other than modest displacement of fossil fuels, no impact on fuel choice is anticipated.
Opportunity for Investments in Infrastructure and Clean Energy/Energy Efficiency	The California ARB estimates a necessary capital investment of over \$27 million to design, construct, and install required landfill GCCS, and an additional \$6.4-\$14 million annually in recurring costs. Total costs for technology, operation, monitoring and maintenance are estimated at approximately \$335 million. ⁶⁴⁶

⁶⁴⁵ Ibid.

⁶⁴⁶ Ibid.

APPENDIX A: Literature review of existing policies

Impact on Different Sectors of the Economy	<p>California ARB estimated the following costs to affected businesses over the life of the measure:</p> <ul style="list-style-type: none">• Capital: \$8.1 million• Annual Operations and Maintenance (O&M): \$43 million• Monitoring: \$60 million• Reporting: \$54,200• TOTAL: \$111 million <p>Additionally, California ARB estimated the following costs to affected government agencies which manage landfills:</p> <ul style="list-style-type: none">• Capital: \$19 million• Annual O&M: \$105 million• Monitoring: \$101 million• Reporting: \$250,000• TOTAL: \$225 million <p>Regulatory costs are estimated to range from \$25,000-\$1.2 million annually.⁶⁴⁷</p>
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18.4 Household Impacts and Co-Benefits

Over the life of the measure, the ARB calculated that the Landfill Methane Control Measure would cost the average California household \$0.09 per month.⁶⁴⁸ This cost would not be expected to significantly impact household consumption and spending.

As noted, the federal NSPS regulation requiring landfill GCCS at large gassy landfills was not developed to manage CH₄. Rather, it targets volatile organic compounds (VOCs) and NMOCs which are harmful to air quality and present health concerns. However, the technology for mitigating these compounds – combustion – also destroys the methane contained in LFG. For landfills regulated under NSPS, the destruction and management of methane could thus be considered a co-benefit. Conversely, a policy that targets methane for destruction will have the co-benefit of mitigating VOCs and NMOCs.⁶⁴⁹ Table 53 shows the household impacts and co-benefits associated with the California methane control measure.

⁶⁴⁷ Ibid.

⁶⁴⁸ Ibid.

⁶⁴⁹ Ibid.

Table 53: Household Impacts and Co-Benefits of the CA Landfill Methane Control Measure

California	
Effect on Household Consumption and Spending	Costs associated with the Landfill Methane Control Measure are borne directly by landfill operators and regulating agencies. However, some costs will be passed to consumers in the form of increased waste disposal costs. Over the life of the measure, California ARB calculated that the measure will cost each California approximately \$0.09 per month.
Measures to Mitigate to Low-income Populations, or Economic Impact	None noted.
Significant Co-benefits	<p>Installation of landfill GCCS reduces toxic NMOCs from landfills. California ARB estimates the following NMOC reductions:</p> <ul style="list-style-type: none"> • 2011: 13,700 tons • 2015: 21,300 tons • 2020: 22,800 tons <p>Conversely, combustion of landfill gas generates nominal levels of criteria pollutants, but the California ARB estimates that NO_x and CO are not expected to increase at subject landfills.⁶⁵⁰</p>

⁶⁵⁰ Ibid.

19 Agriculture and Forestry Sequestration and Emission Reduction Options

Estimates of emissions from the agriculture sector have increasingly shown its significance to global emissions, while forests have been increasingly used as an emissions mitigation tool through carbon capture and storage. This is highlighted in the 2011 U.S. National Emissions Inventory which shows the agriculture sector to be responsible for around 8% of total U.S. emissions while Land Use, Land Use Change, and Forestry (LULUCF) are a net sink, offsetting about 14% of total U.S. emissions.⁶⁵¹

Washington State has investigated different ways to incorporate these sources into their policies to both reduce emissions from agriculture and land use changes, and enhance the sequestration and storage of carbon in forests. In 2008 Washington States Forrest Sector Workgroup released a report that identified potential policy options that addressed the LULUCF sector. The recommendations made were incorporated into a joint report by the Washington State Departments of Ecology and Department of Commerce on “Growing Washington’s Economy in a Carbon-Constrained World”.

The recommendations from these reports were created under the assumption that Washington State would be joining the Western Climate Initiative and its regional cap and trade program. The focus of these recommendations is the development of offset protocols that would be used to incentivize projects that improve agricultural practices and limit deforestation from which offsets could be sold to regulated entities to help meet their emission caps. These recommendations included developing offset protocols under a cap trade program for;

- Avoided Conversion (conserving developable forest lands permanently),
- Urban Forests (urban tree planting programs),
- Forrest Management (improving and ensuring long-term carbon storage through improved management techniques).⁶⁵²

The Joint departmental report also included recommendations on Agricultural offset protocols including;

- Improved soil carbon and nitrogen management on both working agricultural and conservation lands.
- Cattle manure management that captures and destroys methane.⁶⁵³

Emissions from LULUCF were also addressed in the report with recommendations outside the structure of a cap and trade program. These recommendations were based on following and enhancing the Growth Management Act, which attempts to the balance the need for further development required to accommodate the projected 1.5 million additional state residents by

⁶⁵¹ <http://www.epa.gov/climatechange/ghgemissions/sources.html>

⁶⁵² http://www.ecy.wa.gov/climatechange/2008FAdocs/11241008_forestreportversion2.pdf

⁶⁵³ <https://fortress.wa.gov/ecy/publications/publications/0801025.pdf>

2025 while limiting the environmental impacts of that development. These recommendations are made on the principal of limiting development in rural and forest lands and instead directing development to high density multi-use urban areas.³

19.1 Examples of Similar Offset Programs

California's Air Resources Board has adopted as part of their cap and trade program an offsets protocol for forestry projects and the Regional Greenhouse Gas Initiative (RGGI) is in the process of adopting a new forestry offset protocol based on California's to replace their existing one⁶⁵⁴. Both of these target similar project types as those identified above. The effectiveness of these cannot be judge currently as California program is too new and RGGI covered entities have thus far not invested in offsets because the emission cap has not been approached and the cost of emission allowances remains far below the cost of developing offset projects.

The Clean Development Mechanism (CDM), which is the offset provider for countries who wish to use offsets as a means to meet their commitments under the UNFCCC's Kyoto Protocol agreement and is a large scale example of this type of system. The CDM has addressed several of the offset requirements such as additionality, and has been used as a reference and guide for the development of other offset program protocols. The CDM expects to issue around 8 million certified emission reduction credits (CERs), each of which is equivalent to 1 metric ton of CO2 reductions, from currently registered LULUCF projects by 2020.⁶⁵⁵

19.2 Lessons Learned

There is still debate over the legitimacy of carbon offsets and whether they are providing real reductions, or if they simply allow cap and trade covered entities to continue emitting at high levels. Offsets for project types such as forest conservation, which provide credits for not cutting down an existing forest under the premise that it would have been cut down in a business as usual baseline, are particularly criticized because essentially no change has actually been made yet an offset credit has been given. The majority of offset protocols are predicated on ensuring "additionality", that the action that is reducing emissions or avoiding emissions wouldn't have been done anyway, that the project is additional to business as usual. This opens up all offsets for criticism because it is very difficult to predict or forecast what would have happened in the absence of the policy.⁶⁵⁶

New Zealand's cap and trade program has come under fire recently as it allowed U.N Emission Reduction Units (ERUs) in uncapped amounts to be used to offset government issued emission allowances (NZUs). The ERUs were much cheaper, at 13 cents due to an overabundance, which

⁶⁵⁴ RGGI Program Review News Release: RGGI States Propose Lowering Regional CO2 Emissions Cap 45%, Implementing a More Flexible Cost-Control Mechanism;

http://www.rggi.org/docs/PressReleases/PR130207_ModelRule.pdf

⁶⁵⁵ <http://cdm.unfccc.int/Statistics/Public/CDMinsights/index.html>

⁶⁵⁶ <http://sfpublicpress.org/news/2013-07/californias-market-for-hard-to-verify-carbon-offsets-could-let-industry-pollute-as-usual>

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dragged the price of NZUs down from \$7 to below 2\$. This also gave landowners who would be required to surrender 1 NZU or ERU for every 2 tons of emissions an opportunity to cheaply cover the cost of high emissions, which for a landowners who wished to convert their land from forest to another use the opportunity to sell their NZUs on the market and then buy the much cheaper ERUs to cover their emissions, allowing significant profits while drastically increasing emissions⁶⁵⁷. This caused emissions from deforestation to rise to 8.2 million metric tons in one year compared to just 200,000 metric tons a year earlier.⁶⁵⁸ This is a cautionary tale not about LULUCF offsets specifically but about what offsets are allowed, from what sources, and in what quantities. Allowing offsets can clearly have unintended consequences under a cap and trade program if not carefully integrated.

⁶⁵⁷ Owners of land with forests planted before 1990 are forced to take part in the ETS and are given carbon permits for each tonne of carbon stored in their trees. When they harvest forests they are forced to surrender permits and when new forests are planted they receive additional ones

⁶⁵⁸ http://www.pointcarbon.com/polopoly_fs/1.2518903!CMANZ20130816.pdf